[Canada] St. Laurence ~~seaway~~ authority
[General publications]
[G-1] St. Laurence Seaway tolls and traffic; analyses and recommendations, by J. Kates and Associates. 1965.

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ST. LAWRENCE SEAWAY TRAFFIC STUDIES

Seaway Tolls Analysis and Recommendations

Prepared by:

J. Kates and Associates
20 Spadina Road
TORONTO 4, Ontario.

for

THE ST. LAWRENCE SEAWAY AUTHORITY

R. Campbell
Project Director

December, 1965

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ST. LAWRENCE SEAWAY TOLLS AND TRAFFIC

ANALYSES AND RECOMMENDATIONS

Prepared for

The St. Lawrence Seaway Authority

by

J. Kates and Associates

This report was prepared for the St. Lawrence Seaway Authority and deals with specific analyses arising from tolls and their implications, and includes references relating to domestic and governmental policy that are opinions expressed by the consultants.

The comments reflect the views of the consultants who are responsible for the facts and the accuracy of the data presented herein.

December 1965.

Part 1

Seaway Tolls Analyses and Recommendations with supporting appendices.

Part 2

A study of potential iron ore traffic volume through the St. Lawrence Seaway to 1980.

Part 3

Potential grain traffic on the St. Lawrence Seaway to 1985.

J. KATES AND ASSOCIATES
Management Consultants

A DIVISION OF KCS LIMITED

20 Spadina Road, Toronto 4, Ontario, 924-3381

June 1, 1966.

Dr. Pierre Camu,
President,
The St. Lawrence Seaway Authority,
396 Cooper Street,
Ottawa 4, Ontario.

Dear Dr. Camu:

While we originally prepared our reports solely for your internal use, we now understand that our reports are to be published. As you know, in addition to preparing the reports we have carried out a great number of calculations of toll requirements for the Montreal-Lake Ontario section subject to different assumptions of traffic growth, Seaway capacity, operating costs and revenue splits. We are enclosing some examples of these calculations which you may wish to enclose with our reports.

The examples show the year to year effect of the toll revenue on the debt position of the Authority until the year 2009 and demonstrate that moderate toll adjustments are sufficient to meet the Authority's obligation in respect to the Montreal-Lake Ontario section.

Enclosed is also a memorandum which Mr. Campbell, our project director had prepared and given to your economist, Mr. Sainsbury some time ago. Since we would preface any published report with a general outline of the reasoning for charging tolls, we would appreciate if this memorandum were attached to the report as well.

Yours sincerely,

J. Kates.

J. Kates.

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THE ROLE THAT SEAWAY TOLLS PLAY

Seaway tolls are the price of the service the Seaway provides. In a free market economy prices perform the fundamental role of allocating resources where they can be used most efficiently. As a minimum requirement the price of a service in a free market must cover the cost of providing that service or the service is no longer made available. As a rule, in a free market prices cover the costs plus a profit. The margin of profit is the index of attractiveness for new investment to provide more of the particular services which are most in demand.

The Seaway provides a transportation service in a market in which the prices are being determined more and more by the free play of competition; but one in which a large portion of investment decisions are made by governments. The minimum requirement for making these investment decisions rational is that the prices of the services they afford at least cover the cost of the investment within a reasonable period of time.

If the Seaway traffic cannot afford the price of Seaway tolls (let alone a profit) it simply means that other routes or other commodity exchanges can be effected more cheaply. If this is the case, there is no economic justification for the Seaway.

This argument is particularly valid when new investment in the Seaway is considered. If the price of Seaway services cannot be high enough to pay for the expansion of facilities, the expansion or modification is not justified. The resources that would be used in such an expansion or modification of the

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Seaway would be more profitably employed in other ways by government or private business.

The foregoing argument is, to repeat, the fundamental economic basis for Seaway Tolls. The secondary, but equally important, argument for Seaway tolls is based on the international nature of the Seaway. It is simply that the capital maintenance and operating costs of the Seaway are borne substantially by Canada, but the benefits are shared with United States and international shipping interests. Either Canada and the United States should share these costs, or they should be recovered through tolls. The use of tolls is the most equitable means of sharing the cost among all Seaway users.

The basic arguments for Seaway tolls are modified to some extent by other considerations. The first is that both in principle and in practice tolls cannot perform their function retroactively. For instance, Seaway tolls being considered now should not be required to recover the cost of the original Welland Canal or of channel improvements where there was never an intention of imposing user charges and the use of these improvements developed accordingly. In any case Canada's expenditure on the Welland has been balanced by U.S. expenditure on the channel between Lake Erie and Lake Huron and at the locks between Lake Huron and Lake Superior.

The second major consideration is recognition of the role the Seaway plays in the development of competition in the supply of transportation services. However, the establishment of the Seaway is now a fact and future expansion can only be

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justified if it is competitively sound, that is, if it can be paid for out of user charges.

A third consideration is regional development. The Seaway is particularly important to the development of the Quebec-Labrador iron ore deposits and will probably play a somewhat similar role in respect of the potash developments in Western Canada. The Seaway is important to the United States Great Lakes hinterland for the development of overseas general cargo and grain trade. The arguments for low Seaway tolls to subsidize regional development are basically very weak, because the effect is very indirect and uncontrollable. If regional development is to be subsidized it is much better to do it by direct and specific meansures. Less money is required for the same effect, better control is possible and, of course, political boundaries are respected.

The fourth and final consideration is the initial impact which implementation of tolls sufficient to meet all costs would have. If it were to cause a serious disruption of services already established, in effect a disinvestment, then the implementation would have to be modified.

The priorities in establishing the level of tolls is logically based on the re-allocatability of the expenditures they are intended to cover. These priorities are as follows:-

(i) Tolls should first cover current operating and maintenance costs.

(ii) Second in order of priority are the debt carrying charges.

(iii) Third in order of priority is the amortization of the debt or capital investment in the Seaway.

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(iv) Fourth in priority is the cost of new investment and operating costs in expanded facilities.

Unless all four levels of priorities can be covered by tolls, there can be no justification of new or expanded Seaway facilities. It is conceivable, however, that the savings possible through larger locks might so expand the traffic potential of the Seaway as to make tolls covering the four priority levels more feasible than tolls covering the first three only. This is a matter that has not been studied and no opinion can be given at this time.

In general none of the historical, regional and political considerations related to tolls today justify extensive compromise of the economic principle that the Seaway should pay its way. The main consideration is how such a policy should be implemented as to effect the least possible disruption of present service on the Seaway.

R. M. Campbell,

J. KATES & ASSOCIATES.

SAMPLE CALCULATION OF TOLL RATE REQUIRED TO MEET STATUTORY OBLIGATIONS OF THE ST. LAWRENCE SEAWAY AUTHORITY BY 2009

The sample calculations shown are based on the medium J. K. A. forecast, with assumed capacity limits of 60, 65 and 70 million tons.

NOTE: Cargo tonnage is expressed in millions of tons.

Toll rate refers to the rate share accruing to the St. Lawrence Seaway Authority. In 1965 this share was 71% of an average toll of 50.27 cents per cargo ton of traffic, or 35.7 cents per ton. This rate is used for 1966. This rate was then increased as of 1967 until the debt outstanding was reduced to zero by the year 2009.

SLSA share of revenue is the toll rate shown times the cargo tonnage forecast.

Opt. costs (incl. replacement provision) is the cost of operating and maintaining the Montreal-Lake Ontario section of the Seaway as explained in Appendix B2 of the report, Seaway Tolls Analysis and Recommendations

Operating income is the amount of revenue left after operating and maintenance costs are paid.

Interest at 4.391% is the interest on the debt outstanding as of the previous year end. See Appendix B referred to above.

Debt O/S is the debt outstanding as of the year end including accrued interest. See also Appendix B.

The following table shows the results of sample calculations based on the J. K. A. forecasts. These results are expressed in terms of the increase in Seaway toll rates, based on a 72% share to Canada, that would be required to cover all the costs within the Statutory period. These calculations cover the extreme range of conditions which we foresee as possible at this time. The most likely development in our opinion is centred about the medium forecast and a 65 million ton capacity limit.

Capacity	Low Forecast %	Medium Forecast %	High Forecast %
60	19.4	17.1	13.9
65	15.8	10.8	6.6
70	15.8	5.9	0.5
75	15.8	2.0	-

SAMPLE CALCULATION

THE ST. LAWRENCE SEAWAY AUTHORITY
ST. LAWRENCE RIVER SECTION
ESTIMATED OPERATING INCOME INTEREST AND DEBT OUTSTANDING 1967-2009

YEAR	CARGO TONNAGE	TOLL RATE	SLSA SHARE OF REVENUE	OPT.COST(INC REPLACEMENT) PROVISION	OPERATING INCOME	INTEREST AT 4.391 %	DEBT O/S
1965	0.0	0.000	0.000	0.000	0.000	0.000	353.495
1966	43.6	357.000	15.565	4.150	11.415	15.522	357.602
1967	44.8	421.430	18.880	4.300	14.580	15.702	358.724
1968	46.1	421.430	19.428	4.475	14.953	15.752	359.523
1969	49.0	421.430	20.650	4.650	16.000	15.787	359.309
1970	51.7	421.430	21.788	4.825	16.963	15.777	358.124
1971	55.0	421.430	23.179	4.960	18.219	15.725	355.630
1972	56.7	421.430	23.895	5.090	18.805	15.616	352.441
1973	58.7	421.430	24.738	5.200	19.538	15.476	348.379
1974	60.0	421.430	25.286	5.350	19.936	15.297	343.740
1975	60.0	421.430	25.286	5.480	19.806	15.094	339.028
1976	60.0	421.430	25.286	5.615	19.671	14.887	334.244
1977	60.0	421.430	25.286	5.745	19.541	14.677	329.380
1978	60.0	421.430	25.286	5.890	19.396	14.463	324.447
1979	60.0	421.430	25.286	5.890	19.396	14.246	319.298
1980	60.0	421.430	25.286	5.890	19.396	14.020	313.922
1981	60.0	421.430	25.286	5.890	19.396	13.784	308.311
1982	60.0	421.430	25.286	5.890	19.396	13.538	302.453
1983	60.0	421.430	25.286	5.890	19.396	13.281	296.338
1984	60.0	421.430	25.286	5.890	19.396	13.012	289.954
1985	60.0	421.430	25.286	5.890	19.396	12.732	283.291
1986	60.0	421.430	25.286	5.890	19.396	12.439	276.334
1987	60.0	421.430	25.286	5.890	19.396	12.134	269.072
1988	60.0	421.430	25.286	5.890	19.396	11.815	261.491
1989	60.0	421.430	25.286	5.890	19.396	11.482	253.578
1990	60.0	421.430	25.286	5.890	19.396	11.135	245.316
1991	60.0	421.430	25.286	5.890	19.396	10.772	236.693
1992	60.0	421.430	25.286	5.890	19.396	10.393	227.690
1993	60.0	421.430	25.286	5.890	19.396	9.998	218.292
1994	60.0	421.430	25.286	5.890	19.396	9.585	208.481
1995	60.0	421.430	25.286	5.890	19.396	9.154	198.240
1996	60.0	421.430	25.286	5.890	19.396	8.705	187.549
1997	60.0	421.430	25.286	5.890	19.396	8.235	176.388
1998	60.0	421.430	25.286	5.890	19.396	7.745	164.738
1999	60.0	421.430	25.286	5.890	19.396	7.234	152.576
2000	60.0	421.430	25.286	5.890	19.396	6.700	139.880
2001	60.0	421.430	25.286	5.890	19.396	6.142	126.626
2002	60.0	421.430	25.286	5.890	19.396	5.560	112.790
2003	60.0	421.430	25.286	5.890	19.396	4.953	98.347
2004	60.0	421.430	25.286	5.890	19.396	4.318	83.270
2005	60.0	421.430	25.286	5.890	19.396	3.656	67.530
2006	60.0	421.430	25.286	5.890	19.396	2.965	51.100
2007	60.0	421.430	25.286	5.890	19.396	2.244	33.948
2008	60.0	421.430	25.286	5.890	19.396	1.491	16.043
2009	60.0	421.430	25.286	5.890	19.396	0.704	-2.649

THE ST. LAWRENCE SEAWAY AUTHORITY — SAMPLE CALCULATION

ST. LAWRENCE RIVER SECTION

ESTIMATED OPERATING INCOME INTEREST AND DEBT OUTSTANDING 1967-2009

YEAR	TONNAGE	TOLL RATE	SLSA SHARE OF REVENUE	OPT.COST(INC REPLACEMENT) PROVISION	OPERATING INCOME	INTEREST AT 4.391 %	DEBT O/S
1965	0.0	0.000	0.000	0.000	0.000	0.000	353.495
1966	43.6	357.000	15.565	4.150	11.415	15.522	357.602
1967	44.6	398.088	17.870	4.300	13.570	15.702	359.734
1968	46.1	398.088	18.359	4.475	13.914	15.796	361.616
1969	49.0	398.088	19.546	4.650	14.896	15.879	362.599
1970	51.7	398.088	20.523	4.825	15.798	15.922	362.723
1971	55.0	398.088	21.939	4.960	16.979	15.927	361.672
1972	56.7	398.088	22.617	5.090	17.527	15.881	360.026
1973	58.7	398.088	23.415	5.220	18.195	15.809	357.640
1974	60.9	398.088	24.292	5.350	18.942	15.704	354.401
1975	62.6	398.088	24.970	5.480	19.490	15.562	350.473
1976	64.[illegible]	398.088	25.848	5.615	20.233	15.369	345.629
1977	65.0	398.088	25.928	5.745	20.183	15.177	340.623
1978	65.0	398.088	25.928	5.890	20.038	14.957	335.542
1979	65.0	398.088	25.928	5.890	20.038	14.734	330.238
1980	65.0	398.088	25.928	5.890	20.038	14.501	324.701
1981	65.0	398.088	25.928	5.890	20.038	14.258	318.921
1982	65.0	398.088	25.928	5.890	20.038	14.004	312.887
1983	65.0	398.088	25.928	5.890	20.038	13.739	306.588
1984	65.0	398.088	25.928	5.890	20.038	13.462	300.013
1985	65.0	398.088	25.928	5.890	20.038	13.174	293.149
1986	65.0	398.088	25.928	5.890	20.038	12.872	285.983
1987	65.0	398.088	25.928	5.890	20.038	12.558	278.503
1988	65.0	398.088	25.928	5.890	20.038	12.229	270.694
1989	65.0	398.088	25.928	5.890	20.038	11.886	262.543
1990	65.0	398.088	25.928	5.890	20.038	11.528	254.033
1991	65.0	398.088	25.928	5.890	20.038	11.155	245.150
1992	65.0	398.088	25.928	5.890	20.038	10.765	235.877
1993	65.0	398.088	25.928	5.890	20.038	10.357	226.197
1994	65.0	398.088	25.928	5.890	20.038	9.932	216.091
1995	65.0	398.088	25.928	5.890	20.038	9.489	205.542
1996	65.0	398.088	25.928	5.890	20.038	9.025	194.530
1997	65.0	398.088	25.928	5.890	20.038	8.542	183.034
1998	65.0	398.088	25.928	5.890	20.038	8.037	171.033
1999	65.0	398.088	25.928	5.890	20.038	7.510	158.506
2000	65.0	398.088	25.928	5.890	20.038	6.960	145.428
2001	65.0	398.088	25.928	5.890	20.038	6.386	131.776
2002	65.0	398.088	25.928	5.890	20.038	5.786	117.524
2003	65.0	398.088	25.928	5.890	20.038	5.160	102.647
2004	65.0	398.088	25.928	5.890	20.038	4.507	87.117
2005	65.0	398.088	25.928	5.890	20.038	3.825	70.904
2006	65.0	398.088	25.928	5.890	20.038	3.113	53.980
2007	65.0	398.088	25.928	5.890	20.038	2.370	36.313
2008	65.0	398.088	25.928	5.890	20.038	1.594	17.869
2009	65.0	398.088	25.928	5.890	20.038	0.785	-1.384

THE ST. LAWRENCE SEAWAY AUTHORITY
ST. LAWRENCE RIVER SECTION
ESTIMATED OPERATING INCOME INTEREST AND DEBT OUTSTANDING 1967-2009

YEAR	CARGO TONNAGE	TOLL RATE	SLSA SHARE OF REVENUE	OPT.COST(INC REPLACEMENT) PROVISION	OPERATING INCOME	INTEREST AT 4.391 %	DEBT O/S
1965	0.0	0.000	0.000	0.000	0.000	0.000	353.495
1966	43.0	357.000	15.565	4.150	11.415	15.522	357.602
1967	44.2	381.344	17.084	4.300	12.784	15.702	360.520
1968	46.1	381.344	17.560	4.475	13.105	15.830	363.245
1969	49.0	381.344	18.686	4.650	14.036	15.950	365.160
1970	51.7	381.344	19.715	4.825	14.891	16.034	366.303
1971	55.0	381.344	20.974	4.960	16.014	16.084	366.374
1972	56.7	381.344	21.622	5.090	16.532	16.087	365.929
1973	58.7	381.344	22.385	5.220	17.165	16.068	364.832
1974	60.9	381.344	23.224	5.350	17.874	16.020	362.978
1975	62.6	381.344	23.872	5.480	18.392	15.938	360.524
1976	64.8	381.344	24.711	5.615	19.096	15.831	357.258
1977	67.1	381.344	25.588	5.745	19.843	15.687	353.102
1978	69.1	381.344	26.351	5.890	20.461	15.505	348.146
1979	70.0	381.344	26.694	5.890	20.804	15.287	342.629
1980	70.0	381.344	26.694	5.890	20.804	15.045	336.870
1981	70.0	381.344	26.694	5.890	20.804	14.792	330.858
1982	70.0	381.344	26.694	5.890	20.804	14.528	324.582
1983	70.0	381.344	26.694	5.890	20.804	14.252	318.030
1984	70.0	381.344	26.694	5.890	20.804	13.965	311.191
1985	70.0	381.344	26.694	5.890	20.804	13.664	304.051
1986	70.0	381.344	26.694	5.890	20.804	13.351	296.598
1987	70.0	381.344	26.694	5.890	20.804	13.024	288.817
1988	70.0	381.344	26.694	5.890	20.804	12.682	280.695
1989	70.0	381.344	26.694	5.890	20.804	12.325	272.216
1990	70.0	381.344	26.694	5.890	20.804	11.953	263.365
1991	70.0	381.344	26.694	5.890	20.804	11.564	254.125
1992	70.0	381.344	26.694	5.890	20.804	11.159	244.480
1993	70.0	381.344	26.694	5.890	20.804	10.735	234.411
1994	70.0	381.344	26.694	5.890	20.804	10.293	223.900
1995	70.0	381.344	26.694	5.890	20.804	9.831	212.927
1996	70.0	381.344	26.694	5.890	20.804	9.350	201.473
1997	70.0	381.344	26.694	5.890	20.804	8.847	189.515
1998	70.0	381.344	26.694	5.890	20.804	8.322	177.033
1999	70.0	381.344	26.694	5.890	20.804	7.774	164.002
2000	70.0	381.344	26.694	5.890	20.804	7.201	150.399
2001	70.0	381.344	26.694	5.890	20.804	6.604	136.199
2002	70.0	381.344	26.694	5.890	20.804	5.981	121.376
2003	70.0	381.344	26.694	5.890	20.804	5.330	105.901
2004	70.0	381.344	26.694	5.890	20.804	4.650	89.747
2005	70.0	381.344	26.694	5.890	20.804	3.941	72.884
2006	70.0	381.344	26.694	5.890	20.804	3.200	55.280
2007	70.0	381.344	26.694	5.890	20.804	2.427	36.903
2008	70.0	381.344	26.694	5.890	20.804	1.620	17.720
2009	70.0	381.344	26.694	5.890	20.804	0.778	-2.306

INTRODUCTION

The purpose of this study is to examine as objectively as possible the question of Seaway tolls to determine the influence they have and could have on Seaway traffic. The approach used is to examine tolls in the setting of all factors which determine Seaway traffic volumes.

We wish to acknowledge the splendid assistance of all those in business and government who have contributed toward this study.

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1.0 SUMMARY AND CONCLUSIONS

1.1 Summary

Three main points have come out of this study of Seaway traffic and the factors that will determine its future development.

(i) The future prospects of the Seaway are dependent mainly on the development of efficient harbour and carrier operations and the rate and service orientation of tributary overland transportation systems. Inefficient carrier operations and, in particular, the continued use of small and outmoded vessels, could seriously reduce the competitiveness of the Seaway. Moreover, the employment of too many small vessels could create such pressure on Seaway lockage facilities that additional major investments would be required much sooner than otherwise necessary. If such additions to the Seaway were to be operated and paid for out of tolls, the required increase in tolls would have a serious effect on the attractiveness of the Seaway route.

(ii) Properly applied, Seaway tolls could play a major role in insuring the future competitiveness of the Seaway by encouraging the use of large vessels and the development of efficient carrier operations. In order to do this, tolls must, in part at least, reflect the Seaway capacity utilized. This can be done by levying a per lockage transit toll in lieu of the tolls on GRT.

(iii) Seaway traffic is not very sensitive to present Seaway tolls or moderate changes in those tolls. The main reason is that the present and prospective advantages of the Seaway route would continue to outweigh the small portion of shippers' transportation costs which tolls represent.

The following summarizes the background and analysis leading to these conclusions.

The Seaway is approaching a critical stage in its long history. It has become a very significant link in the transportation system carrying the trade of the inland Great Lakes hinterland with the north eastern regions of the continent and with overseas countries.

Its future depends on it remaining competitive and being able to carry some of the trade more cheaply than is possible with any other means. As long as it affords this opportunity, traffic will continue to grow and the whole North American economy will benefit from the genuine economic competition that the Seaway affords in the supply of major inland transportation.

The key to understanding the role of the Seaway is the recognition that, for most of the traffic it carries, it is a competitive and not an exclusive route. As such, it cannot expect to enjoy special or exclusive privileges in its future development which could be construed to be a mis-allocation of public resources. That is, there is a very strong case for user charges on the Seaway sufficient to amortize investment, particularly major new investment, and to cover operating costs.

Real competition for potential Seaway traffic is on the point of starting. The competitive impact of the Seaway is, and will be, related to the relative volume of traffic it carries. This volume has increased more than five times since 1945, a period during which the tonnage carried by the

North American railways has scarcely changed. The total volume of Seaway traffic has risen from a level of insignificance, relative to total inland commodity traffic, to one of major significance; and there are good future prospects for additional increases.

There is a danger that the potential efficiency and cheapness of transportation services which the Seaway offers may not be realized because of inefficient carrier operations. This would be the result if the carriers and all attending harbour and tributary transportation services do not become geared to the peculiar advantages of the Seaway. These advantages are exemplified in the present operations of the largest bulk carrier vessels which the locks can accommodate, in particular the self-loading and unloading vessels, and in the operations of the largest modern ocean-going bulk-cargo and mixed-cargo vessels. The operations of these carriers are most likely to remain competitive throughout the foreseeable future.

The marginal Seaway carrier operations involve the use of small, antiquated vessels and relatively small volume movements of goods at high rates, and it is these movements which the railways could recapture most easily. At the same time, a portion of these movements involves overseas general cargo which is of such a nature that, when and where there is an advantage in using the Seaway route, it outweighs, by a large amount, the significance of tolls or such tolls as might be required in the future.

There are two major disadvantages of the small vessel operations from the point of view of the total Seaway operation. First, these vessels make very inefficient use of the Seaway lockage and canal facilities, as compared with the larger vessels, and they would be the chief reason for adding major canal capacity in the near future. Tolls sufficient to meet the operating and financial costs of such major new investments in the Seaway in the near future would wipe out a large portion of the competitive advantage of the Seaway in moving grain and iron ore. The reduction in traffic volume that could result from such toll increases would obviate additional canal capacity.

Secondly, the operation of small vessels does not encourage the proper development of harbours, ancillary port facilities, or tributary transportation service. The total transportation operations must be developed to the degree of efficiency that guarantees their long-term competitive position.

It is incumbent on those who decide the future policy and operation of the Seaway to consider the efficient development of the whole system. Seaway tolls offer the means by which the Seaway may become more competitive than it could without tolls and, at the same time, put the Seaway on a firm and unassailable fiscal basis. This can be done by redesigning the way in which tolls are levied to make tolls reflect the amount of Seaway capacity utilized. Tolls would, in effect, allocate the use of the Seaway to the carrier systems and commodity flows which

justify the Seaway and assure that it will realize its full potential.

To date, only one role has been considered for Seaway tolls - that of affording revenues to meet the statutory financial requirements of the Seaway entities. The first step toward developing a second role for tolls, as a means of regulating the efficient development of Seaway traffic, is to establish the idea in principle; this could be done by adding a per transit fee that would be the same for all commercial vessels which use the Seaway. As a partial compensation, the toll on GRT should be dropped.

As traffic develops and taxes the capacity of the Seaway, the per transit fee could be increased to encourage the most efficient use of the Seaway facilities. When and if further major additions to capacity become mandatory, they would be amply justified by the efficiency of total Seaway-carrier operations, traffic volumes and revenue flows. Moreover, due consideration could then be given to the advantages of possible new lock dimensions which might afford a possible new level of carrier operating efficiency on the Great Lakes and Seaway.

1.2 The Main Conclusions Respecting the Effects of Toll Rate Changes

(i) An increase of up to 20% would have little effect on the future volume of Seaway traffic.

(ii) Toll increases, with the present rate structure of between 20% and 50%, could cause the diversion of some iron ore traffic from the Quebec-Labrador field to the Atlantic sea-board route. Currently, there is about one million tons of ore routed through the Seaway for steel mills in the Pittsburgh region which could almost as easily use the Atlantic route.

(iii) Apart from iron ore, toll rate increases of up to 50% would probably cause a relatively small diversion of traffic.

(iv) Toll rate increases of over 50%, with the present rate structure, would have a serious enough impact on the economics of iron ore movement that further evaluations of these effects should be made.

(v) Apart from iron ore traffic, tolls could be increased by 100% and the effect on traffic would not likely be greater than a reduction of 5% to 10% from potential levels otherwise.

Changes in toll rate sufficiently great to alter the volume of iron ore movement would seriously disturb the sector of shipping which depends on balancing downbound grain movements with upbound iron ore. Also, the loss of iron ore traffic would not reduce the Seaway capacity requirements because these are determined mainly by the downbound cargo traffic.

1.3 The Main Conclusions Regarding the Structure of Seaway Tolls

The most important single factor determining the amount of cargo which the Seaway can handle in a season is the vessel cargo capacity. It is possible for the present single lock canal system to handle well over one hundred million tons, provided that a sufficient proportion of the ships using the Seaway are in the cargo capacity range of fifteen to twenty-eight thousand short tons. At the same time, the type of carrier operation which these larger ships permit is the type which has the greatest prospect of remaining competitive with railway operations.

Present Seaway tolls are based mainly on cargo tonnage and, to a lesser extent, on cargo capacity. A representative small cargo ship with three thousand tons of general cargo may pay $3,000 and require almost as much canal capacity as a large bulk carrier with twenty-eight thousand tons of cargo, but the latter pays $12,000.

Already about three-quarters of the Seaway cargo traffic is carried in vessels with capacity of ten thousand short cargo tons and over. These vessels require less than half the canal capacity. The remaining quarter of the cargo takes over half the utilized capacity of the Seaway. As long as there is surplus capacity, there is no serious problem but, as soon as the capacity becomes severely limited, it is rather late to start taking remedial action. Either conversion to fewer and larger ships to replace the many small ones, or major increases in canal capacity, require considerable lead time for planning adjustment of operations and execution.

If it is necessary in the national interest of either, or both, Canada and the United States to subsidize Seaway operations, it would be far better to directly subsidize the development of efficient carrier operations as Canada has been doing through ship construction subsidies. Subsidization through the provision of excess Seaway capacity and through low tolls will, in the long run, weaken the competitive position of the Seaway both economically and politically.

The best approach is to alter the system of levying tolls to reflect the capacity utilized. Ideally, such tolls would be based on actual canal lockage time utilized. However, it would be too precipitous to recommend such a scheme immediately. A more feasible approach is to divide the problem in two and let tolls provide the incentive for using large vessels and minimizing "in ballast" movements and leave the problem of speedy ship manoeuvres to canal operations administration.

Since there is a prospect of adequate capacity for some time yet and the conversion to larger ships is already in process, the initial problem is mainly one of establishing a principle; this would, no doubt, accelerate the conversion to more efficient carrier operations as well as larger ships. At the same time, it pushes the tonnage capacity of the Seaway higher and this means that more of the old debts can be amortized before new ones related to major new facilities are acquired.

2.0 THE RELATIVE SIGNIFICANCE OF SEAWAY TOLLS AND TOLL CHANGES

The first question regarding tolls and their effect on traffic is what share of total shippers' costs do they represent; this section examines the relative size of Seaway tolls and possible toll changes as compared with different total cost concepts and figures.

The following hypothetical toll increases bracket the conceivable range of toll rate changes which could be considered, in view of the traffic forecasts made in this study and the financial requirements of the Seaway entities.

TABLE 1

	Bulk cargo ¢ per 2,000 lb.	General cargo ¢ per 2,000 lb.	All cargo ¢ per 2,000 lb.
Average toll rate	42.55	98.20	48.55
Toll rate increases			
+ 10%	4.26	9.82	4.86
+ 20%	8.51	19.64	9.71
+ 50%	21.28	49.10	24.28
+ 100%	42.55	98.20	48.55

Since the Seaway toll comprises only part of the shippers' cost of using the Seaway, the relative significance of toll changes must be measured against appropriate total shippers' cost figures. There are several appropriate cost figures, each of which is relevant to one aspect of the problem. These total costs are :-

(i) The cost or rate for shipping selected commodities through the Seaway.

(ii) The total transportation costs of representative commodities using the Seaway.

(iii) The total amounts of the Seaway shipping costs, total transportation costs and the total cost of goods to receivers.

2.1 In the following Table the hypothetical toll rate increases are related to representative shipping service rates :-

TABLE 2 Toll Rate Changes as Percentages Representative Shipping Service Rates

Bulk Commodities	Seaway Rate per Short Ton	Toll Rate Changes of +10%	+20%	+50%	+100%
	$	%	%	%	%
Iron ore - representative of low value dense bulk commodity movements					
Including toll	2.03	2.1	4.2	10.5	21.0
Excluding toll	1.60	2.7	5.3	13.3	26.6
Wheat - representative of grain cargo movements					
Including toll	3.82	1.1	2.2	5.6	11.1
Excluding toll	3.40	1.3	2.5	6.3	12.5
General Cargo					
Average ocean conference rates to Great Lakes ports are 20% higher than to Atlantic Coast ports					
Including toll	8.81	1.1	2.2	5.6	11.1
Excluding toll	7.83	1.3	2.5	6.3	12.6

2.2 In the following Table, the selected toll rate increases are related to the total of all transportation costs of selected goods, using the Seaway route on part of this journey.

TABLE 3 Toll Rate Changes as Percentages of Representative Total Transportation Costs

	Total Transportation and Handling Costs per Short Ton	Toll Rate Changes of 10%	20%	50%	100%
	$				
Iron Ore	5.27	0.8	1.6	4.0	8.1
Wheat	18.50	0.2	0.5	1.1	2.3
General Cargo	54.28	0.2	0.4	.9	1.8

2.3 The following Table compares the amount of the Seaway tolls and the hypothetical toll rate increases to :-

(i) Estimated total cost of the goods shipped through the Seaway.

(ii) Estimated total transportation and handling costs for those goods, and

(iii) Estimated total Seaway transportation costs.

All based on the 1964 traffic through the Montreal-Lake Ontario Section of the Seaway.

TABLE 4 — Seaway Toll Revenues and Hypothetical Increases in Toll Rates Related to Cost Factors of the 1964 Traffic on the Montreal-Lake Ontario Section of the Seaway (Canadian Dollars)

Estimated Total Cost Aggregates Canadian Dollars	Toll Rate Increases of 10%	20%	50%	100%
	would amount in millions of dollars to .			
	$1.9	$3.8	$9.5	$19.1
	and represent in percentages			
Total cost (value) of goods shipped through this section of the Seaway ($3.0 billions of dollars)	% .06	% .13	% .32	% .65
Total transportation costs ($600 millions of dollars)	.32	.63	1.59	3.25
Total Seaway transportation costs including tolls ($175 millions of dollars)	1.11	2.23	5.43	11.14

In summary these Tables show that the tolls are a relatively small fraction of the total costs which determine trade and trade patterns. However, the influence tolls have may be greater or less than these proportions indicate. The next four sections examine the relationships of the supply and demand of Seaway transportation service to see if the effect of tolls is greater or less than their proportional size.

3.0 THE RELATIONSHIP OF SEAWAY TOLLS TO SEAWAY CARGO TRAFFIC VOLUMES

In order to give somewhat greater precision to the analysis and discussion that follows we will make use of the classical representation of market supply and demand functions (see following page).

The imposition of tolls on traffic through the Seaway has the effect of shifting the curve representing the supply of shipping services to the left, as indicated on the graph. This has the effect of reducing the revenue rate of the shipping services and the total volume of traffic. The cost of the tolls is shifted partly to the shippers and part of it is born by the ship operators in the form of reduced rates on cargo.

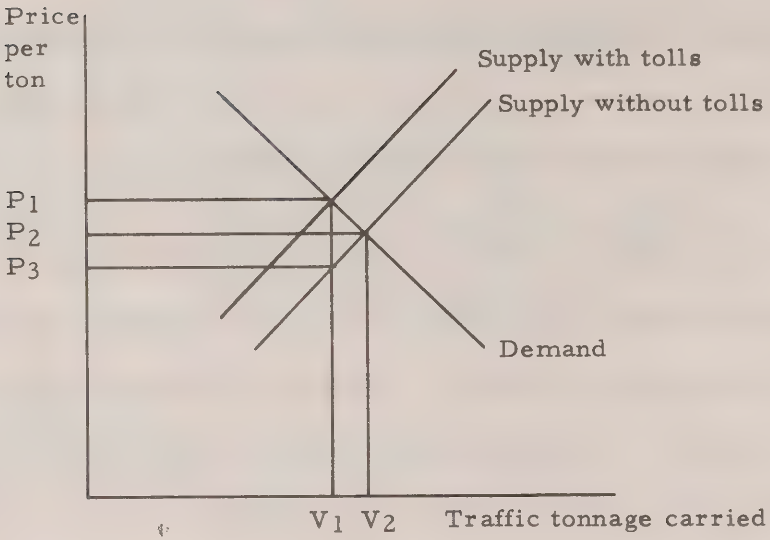
The amount of reduction in traffic volume resulting from the Seaway tolls, or a change in toll level, depends on the relative size of the toll as compared to average rates for cargo and the elasticities, or slopes, of the supply and demand curves.

If both the demand and supply curves are very elastic, the reduction in traffic volume will be, in relative terms, greater than the toll rate change. If one or the other curve is quite inelastic, the reduction in traffic will be less in relative terms than the toll rate change.

There is only one measure of the volume of Seaway traffic, but there are three measures relevant to the price scale. The demand, under certain

SEAWAY TRANSPORTATION SERVICES

SUPPLY AND DEMAND



P_1 = The average price (rate) for Seaway transportation service with tolls.

P_2 = The average price (rate) for Seaway transportation service without tolls.

P_3 = The average price (rate) received by the suppliers of transportation services when tolls apply.

V_1 = The volume of cargo traffic with tolls.

V_2 = The volume of cargo traffic without tolls.

$P_1 - P_3$ = The average toll rate.

$V_2 - V_1$ = The reduction in traffic volume due to tolls.

$$V_2 - V_1/V_2 = f\ [(P_1 - P_3)/P_2,\ \text{elasticity of demand, elasticity of supply}]$$

NOTE: An increase in the toll rate from P_1 to P_3 has the effect of shifting the supply curve upwards. Part of the increase is absorbed by the supplier and part by the buyer.

conditions, is a function of the final demand for the trade goods that make up the cargo traffic. It is also a function of the total amount of transportation involved in the trade and, thirdly, a function of the transportation on the Seaway itself.

This type of demand and supply analysis is based on static conditions and the actual situation of the Seaway is one of dynamic growth in both supply and demand. The effects of the growth qualification are mainly to make the real supply relationship somewhat more elastic because it becomes a function of new investment, and to make the demand somewhat less elastic.

With these concepts in mind, we can consider the characteristics of the demand and supply functions to determine whether the effects of Seaway tolls, and changes in toll levels, are likely to be greater or less than the proportional size of the tolls.

4.0 THE DEMAND FOR TRANSPORTATION SERVICES THROUGH THE SEAWAY

With few exceptions, the Seaway represents but one link in the transportation of most commodities routed through it. The demand for Seaway transportation service is, therefore, only part of the demand for all the transportation services involved in the foreign and domestic trade of the Great Lakes and mid-continent hinterland of North America. These transportation services in turn are but one component of the final demand, which is for the goods themselves. The total value of Seaway services related to traffic through the Montreal-Lake Ontario Section in 1964 is estimated at one hundred and seventy-five million dollars, or approximately 6% of the final demand or value of the goods themselves.

A major consequence of this fact is that the response of traffic to the advantages or disadvantages of the Seaway route is bound to be sluggish. Small changes in final demand market conditions can easily attract attention away from the Seaway. The market awareness of Seaway disadvantages is, however, bound to be greater than the awareness of its advantages. The reason is simply that traffic using the Seaway has to use an alternative route when the Seaway is closed. Thus, comparisons of alternatives are almost certain when traffic uses the Seaway but can be, and evidently are, avoided when traffic is not routed via the Seaway at any time.

The sensitivity of the demand for Seaway transportation services is, therefore, very inelastic up to the point where an alternative route becomes cheaper. Under such borderline conditions, demand is very elastic or sensitive and theoretically a small change in the price of the Seaway route can switch Seaway traffic to an alternate route.

Section 6.0 examines Seaway traffic for borderline conditions, whilst the following section covers the supply side of Seaway carrier services.

5.0 THE SUPPLY OF SEAWAY TRANSPORTATION SERVICES

There are three main types of ship service offered on the Great Lakes: ocean conference liner service, ocean tramp ship service, and laker service.

Conference line service is confined largely to general and mixed cargo service. (It is estimated that about 60% of general cargo overseas traffic of the Great Lakes ports is carried on conference lines.) The share of cargo being carried by conference lines all over the world has been shrinking. One reason is the competition from tramp line service; another is that many items which once comprised a large part of liner cargo now move in such volumes that they are attractive to tramp type service and/or special contract arrangements. Also many commodities which were formerly handled in relatively small container units are now handled in bulk; vegetable and animal oils are examples. The basis of conference line service is rate stability and scheduled service and their rate policies are, ostensibly, quite inflexible. However, the conference lines are showing evidence of willingness to negotiate particular commodity rates when the traffic involved is substantial and may be lost.

When the Seaway opened, the conference lines absorbed the cost of moving general cargo through dock terminals on the Great Lakes. This spring they served notice that they would no longer do this, in order to bring their policy on the Great Lakes in line with their practice at the sea coast ports. This change amounts to $1.80 per ton of general cargo. This

illustrates, first, that the conference lines were ready to absorb this amount of cost in order to develop the traffic and, secondly, that they can now make this increase without jeopardizing their traffic volumes. In conclusion, it appears that the conference lines would pass on any increase in tolls except in cases where this would cause traffic to switch to other routes.

Ocean tramp service rates are determined by a large number of factors in world-wide shipping volumes and conditions. The fairly wide fluctuations in contract rates which are typical of ocean tramp service attest mainly to the wide fluctuations in the level of demand which occur from time to time. The extreme operating flexibility of this service means that the tramp ships are just as willing to pick up a cargo of wheat at Montreal or Boston as at Fort William or Chicago, if the profitability is the same. Therefore, if the cost of the Seaway route made it non-competitive with the overland movement of grain to the ports, the tramp service would flock to the coastal ports. However, as long as the Seaway route offers relatively profitable trade to tramp ocean vessel service, the supply of this service will tend to be inelastic.

Laker ships, in contrast, are confined to service in season on the Seaway and Great Lakes, and this condition makes this type of service relatively unresponsive or inelastic in the short run, and in the face of a decline in demand. However, in the face of a strong growth in demand, the supply of laker service is more elastic or responsive because it is

determined by the rate of new investment. A qualification that must be added is that there are still a considerable number of old laker vessels whose amortization costs have long been covered. They are pressed into service when the demand surges and are just as easily put to anchor when it slackens. As these ships are gradually scrapped, the supply of laker services will become a little less elastic, since the capital costs of the newer fleet are a much larger proportion of their total operating costs.

A very important characteristic of laker operations is that almost all the larger companies have corporate ties with major users of laker services; only three Canadian lakers operators of significant size are considered to be independent. Two of these operate vessels in the capacity range of twelve to fifteen thousand short cargo tons which are thirty to fifty years old and over, whilst the other has a fleet of six new ships, all of the largest size which can be accommodated in the locks.

The independent operators are more directly subject to the dictates of the market and they are more likely to change their rates as opportunities arise. The two operators using very old and somewhat inefficient ships have very low fixed costs and, in the face of downward pressure on their rates, they would tend to stop operations altogether sooner than the company which has efficient modern vessels with relatively lower operating costs, but high fixed costs.

The tie-in of the majority of U.S. and Canadian lake ship operators with ore, coal, elevator, paper companies, etc., helps to explain the relative stability of lake shipping. Historically grain and ore tonnages have varied considerably from year to year and such proportionate variations in ocean trade would bring about sharp changes in contract rates. The reason for the corporate ties of shipping operators with the major interests using their services is partly due to the early practice of vertical integration in the steel industry. The reason this practice is so extensive is due to the fact that laker operations are in direct competition with the railways and being, to a large extent, international, they were subject to destructive competition by the railways; the corporate ties formed have helped to guarantee a share of the business. In addition to the outright benefits of low cost transportation, these ties afforded the users of laker service the very existence of laker operations and have been a means of obtaining rate concessions from the railways.

In spite of the corporate ties, these ships serve everybody. Some companies find they now control a fleet which has many times the capacity which they require for captive traffic but, in order to provide the service they require at competitive costs with other laker operators or the railways, they have to have a minimum number of ships for economic operations.

The net effect of the corporate connections of the laker ship operations is to make the supply of laker service more inelastic than would be the case

if they were completely independent. The fact that independent operators have started up in recent years attests to the general profitability of this service through the Seaway.

In summary, the supply of shipping services on the Seaway tends to be inelastic in the face of a declining demand situation and relatively elastic in the face of a strong growth in demand. This means that the carriers would tend to absorb toll increases when the alternative is an absolute decrease in demand for their services. However, the prevailing condition since the Seaway opened has been one of strong growth in demand and, as long as this continues, tolls will tend to be passed on to the shipper.

6.0 BORDERLINE SITUATIONS

For the most part, the cost advantages of using the Seaway are not fully exploited. Consequently, there are not many borderline situations where traffic routing is delicately balanced; of the major commodity movements iron ore and Canadian grain come closest, so far, to fully utilizing the Seaway in this sense. Actually, some Canadian grain moves through the Seaway at a disadvantage on the netback to some Canadian farmers as compared with the Pacific coast ports route or Port Churchill (see Appendix B, Grain Study, p. 35). However, this is a situation in which the routes are really not close substitutes for one another for all markets and, in fact, it would take a differential which would be at least several times the present toll rate to very seriously alter the routing pattern.

The one significant borderline situation is the ore movement through the Seaway and Lake Erie ports into the Pittsburgh area. This area can be supplied for about the same price via U.S. Atlantic ports and currently about one million tons of Canadian ore moves into this area through Conneault. It is unlikely that the entire movement would switch to the Atlantic route unless the differential became substantial, since this movement involves ships which are not suitable for Atlantic port service, but which are involved in the movement of grain in the downbound direction. If a loss of traffic threatened the employment of these ships, there is a strong likelihood that toll changes, within reason, would be absorbed wholly or

partly by the ship operators. The fact that the grain movement complements the ore movement makes such rate adjustment much more feasible.

It is also notable that a considerable volume of Canadian iron ore has been moving into the Chicago area and such ore is competing with Mesabi ore which moves a much shorter distance at less cost. The reason for this is that the shipping cost is only one of the factors used in deciding which mines to exploit.

There is probably very little general cargo traffic on the Seaway that i is in a borderline condition in respect of direct shipping costs, with the exception of Canadian domestic package freight. The direct cost advantage of most of the U. S. general cargo which moves through the Seaway in overseas trade is so high in relation to tolls that these are not an appreciable consideration, structured as they are now. A recent study shows that the average advantage of the Seaway route for a wide sample of export movements of general cargo averages about $8. 81 per ton. *

The Canadian domestic package movement, however, is in direct competition with railway service. The cargo has to be loaded and unloaded

*Draine, Edwin H. Freight Rate Structure on Selected Commodities in Middle Western Foreign Trade for the Chicago Association of Commerce and Industry, January, 1965.

at Canadian ports, whereas the choice with overseas traffic is between unloading at a sea coast port versus unloading at an inland port and trans-shipping by rail to inland distribution points. The domestic service is competing with ocean vessel movements directly into the Lakes and with railway and railway piggyback movements in parallel. Moreover, the distance between Montreal and Toronto is too short for water movements to build up sizeable advantages over railway movements; this service remains viable because it is very efficient and because there is an appreciable volume of general cargo commodity trade originating and destined for points within relatively cheap trucking distance of the ports of call.

The major problem in assessing the attraction or attachment of general cargo commodity to the Seaway route is that many factors, other than direct shipping costs, are taken into account by the shipper. Speed of movement, access to marketing facilities, brokerage facilities and many other special circumstances play their part. Moreover, the development of such ancillary services and conditions is greatly facilitated by year-round employment which the Seaway route cannot offer. For the most part, the relative significance of tolls is very small in this traffic because the costs to shippers using this service range from $15.00 to $60.00 a ton for the water portion of the movement and up to $100.00 and over for the total transportation costs.

7.0 THE RATE OF TRAFFIC GROWTH ON THE SEAWAY RELATIVE TO DIRECT SHIPPING COST ADVANTAGE

If there is a large margin of advantage in using the Seaway route, why has there not been an even greater increase in traffic volume than has actually occurred ? The answer lies partly in the nature of the role the Seaway plays. It is one of the many factors contributing to the feasibility of developing the Quebec-Labrador iron ore mines; the key word here is "developing" because the trade did not exist in any large volume prior to confirmation that the Seaway would be built. That the traffic in iron ore has developed more slowly than expected is due to a number of factors other than direct shipping costs and these have been considered at length in the special report on iron ore.

The Canadian grain traffic was a well-established movement based partly on the use of the Lakes and the old canal of the Lower Seaway. Upon the completion of the Seaway, the movement swung rapidly to the Seaway route throughout; this movement is still a transfer movement to the Lower St. Lawrence ports and relatively little Canadian grain is loaded directly on overseas ships at the head of the Lakes. Ultimately, the development of many more special ocean-laker type vessels may make direct shipping more attractive. In any case, the Seaway is now used to its full potential in terms of its share of the Canadian grain movement.

The United States grain trade has possibilities for a large increase in the share being routed through the St. Lawrence. United States grain shipments abroad amount to over forty million tons annually and currently about 17% of this moves through the Seaway; this represents about 25% of the grain exported from what is considered the hinterland of the United States Great Lakes ports. The main reasons why the Seaway share of this grain trade is not larger are, first, the structure of railway rates has favoured the movement to Gulf and Atlantic Coast ports; secondly, water movement on the Mississippi has been entirely oriented to New Orleans and, thirdly, there had been no previously established pattern of movement through the Great Lakes St. Lawrence River axis. This traffic has grown steadily since the opening of the Seaway, as elevator and harbour facilities adapt to the Seaway requirements and as the pattern of movement becomes established. This season the railway rates for grain moving into the Chicago area were reduced by about 30% or $2.00 per ton and this increases the potential for the movement of corn and soybeans in particular. Further developments in the offing are completion of canal facilities to permit the movement of Mississippi barges into Calumet Harbour and even into the Lakes.

The development of U. S. owned and operated grain storage and transfer facilities at Baie Comeau was an essential step in providing for the transfer movement of U. S. grain by lakers. Canadian facilities were already taxed to capacity, partly because of growing domestic needs for

Western and U.S. feed grains. There are rumours that more U.S. grain storage and transfer facilities may be built on the Lower St. Lawrence River.

Part of the U.S. grain trade through the St. Lawrence complements the overseas general cargo trade; the development of both, therefore, goes hand in hand.

The general cargo trade is the least sensitive of all commodity trade to direct shipping cost considerations. The reasons for this are, first, that the value of the goods is so much higher per ton that the direct shipping costs comprise less of the final cost to the buyer than is the case with bulk goods; second, the requirement for ancillary services supplied by independent operators is much greater (such services are packaging, brokerage and insurance). Also of major importance has been the general tendency in the secondary goods industries of taking transportation for granted. Without a strong pressure for economy in transportation costs, company traffic managers have been generally ignorant of the Seaway advantages and reluctant to learn.

When the Seaway opened, many ocean ships flocked in with some cargo and in search of return cargo - they were rather bitterly disappointed. The established conference lines were naturally reluctant to initiate service through the Seaway, because it meant a costly period of

traffic development and it was seasonal. The result has been that the general cargo traffic has been following a classic growth curve, rather than making an immediate switch to the Seaway.

There is still a large amount of room for growth in general cargo traffic. It is estimated that in 1959 about 10% of the general cargo trade of the Great Lakes hinterland was routed through the Seaway; by 1964 the share rose to about 17%, and it is estimated that it could go as high as 25%.

More spectacular than the growth in commodity traffic has been the growth in size of ships using the Seaway. When the Seaway opened, the average capacity of both laker and ocean ships used in bulk cargo service was about six thousand tons. By 1964, the average capacity of the ocean bulk cargo ships had risen by 75% to ten thousand, five hundred tons and the laker bulk cargo ships doubled their average capacity to twelve thousand tons. It is technically feasible to double the average ship size again - Seaway locks and channels accommodate ocean vessels carrying loads of up to nineteen thousand short tons and laker vessels of up to twenty-eight thousand short tons.

In summary, the traffic on the Seaway did not respond immediately to direct shipping cost advantages inherent in the opening of the new locks and canal because other developments were required, in addition

to access to the Lakes. The size of ships, the structure of rates for inland transportation service, the development of channels and harbours, the development of ancillary services and the development of the idea of using the Seaway all took time and will require more time yet before the Seaway share of traffic is decided.

8.0 THE DIRECT COST ADVANTAGES OF THE SEAWAY ROUTE

The direct cost advantage or disadvantage of the Seaway route for a particular commodity movement is determined by total transportation and handling and storage costs. The costs of Seaway carrier service amount to one-fifth to one-third of the total shipper's costs, and in many kinds of operations 50% and more of these carriers' costs are incurred while ships are in harbour. Obviously the fate of the Seaway depends mostly on what happens in the harbours on the Seaway and overseas, on the high seas, and in overland transportation to and from Seaway harbours.

Most cargo moves at negotiated or contract rates. In the case of wheat, these rates are negotiated ship by ship with regard to most ocean movements and, in all cases, on a short-term basis. Iron ore and coal rates are based on long-term contracts of up to two years. Thus, the rates are a result of a market process which will naturally tend to minimize the relative advantage of the Seaway, as the ship operators try to obtain the best prices or rates possible. Competition between laker and ocean ship operators tends to keep down grain rates on the Lakes. Competition among laker operators themselves and the combined bargaining power of the iron ore companies and corporates ties controls iron ore rates.

The full potential advantage of the Seaway can be increased by improvements in vessel scheduling, better loading assembly, balancing of traffic by direction, and reduction in canal transit times.

The balance of traffic is an important factor in Seaway operations. The forecasts made in this study indicate that up and down traffic through the Montreal-Lake Ontario Section of the Seaway will probably be in fairly close balance in the future, if an appreciable movement of potash develops in the downbound direction.

Improvements in the passage time through the canal themselves have an appreciable overall effect on ship operations and recent improvements in the operations of the Welland Canal have been worth as much as the cost of the Seaway tolls themselves to ships which are able to make use of the time saved.

The direct cost advantages of the Seaway route for general cargo have been recently investigated fairly extensively for a selection of United States export commodities from inland points which are tributary to Great Lakes ports. On the average, the direct shipping cost margin is about $8.81 per ton of general cargo. The total shipping cost of the commodities selected was $54.33. While the $8.81 per ton advantage appears high in relation to tolls, it is only 16% on the total shipping cost and, at the current frequency and magnitude of freight rate

changes, a 16% advantage is not an entirely secure advantage. However, there are anomalies in the railway rate structure which make some inland points tributaries of New Orleans for one commodity and tributaries of Chicago for another. The recent reduction in rail grain rates to Chicago is a step toward eliminating some of the important anomalies. Continued pressure by interests associated with the Lake ports will likely lead to more rate adjustments favouring Seaway traffic.

The composition of the total transportation costs for the sample of commodity exports through the lakes, averages about 25.1% railway or trucking cost to the port, 70% ocean conference rate, and 4.9% to cover sundry charges, such as tolls. The advantage of the Seaway route comes from the savings in overland costs. The ocean conference line freight rates at the Lake ports average 20% more than the rates from New York, but they are about the same at New Orleans. The railway rates to the lake ports are about 60% less than they are to Baltimore or New York and about 50% less than to New Orleans.

The advantages of the Seaway route for trade in commodities originating or destined for Lake ports is, of course, substantially greater than it is for inland points because the overland costs are greatly reduced. <u>Since the United States population living on or very close to the Great Lakes approaches that of all Canada, there is a large market for which the Seaway provides an almost unassailable advantage.</u>

Similarly, on the Canadian side, the direct access to the Oshawa - Toronto - Hamilton - St. Catharines urban industry and markets provided by the Seaway is virtual assurance of the continued value of the Seaway for general cargo trade.

9.0 FUTURE PROSPECTS OF THE SEAWAY ROUTE

The basic disadvantage of the Seaway is the fact of its seasonality. The four months of hiatus in activity on the Seaway means either that commodities in trade must be kept in inventories or must be shipped by alternate routes. To some extent, agricultural commodities are an exception, in that they have to be inventoried because of production seasonality. In the case of almost all other commodities, the cost of maintaining the inventories required by the seasonality of the Seaway would be about 5% of the value of the goods. Since the cost of total transportation of the goods in trade through the Seaway is about 20% of the value of the goods, the inventory costs due to seasonality would add a 25% penalty to the total costs of using the Seaway route.

In actual practice, the costs of inventories of this size is partly avoided by using alternative routes in the winter season, but even this does not avoid an overall economic disadvantage, due to seasonality; it shifts the burden of inventory costs onto the transportation sector which must keep reserve capacity to handle the seasonal traffic peaks. On the Seaway the eight month operating season means that the facilities and ships can only ship two-thirds of what they could in a twelve month season, or that 50% more capacity is required for an eight month season than for a year-round operation.

In today's economic and political climate in which business is becoming much more sensitive and aware of distribution costs and government policy is directed to full employment, the basic economic costs of the seasonality of the Seaway are bound to become reflected more and more in direct costs. At present, they are obscured by being absorbed by the labour force which suffers the brunt of the seasonality and by virtue of the large amount of slack there is in the entire overland transportation system; because of this slack, the fluctuations in the use of seasonally alternated routes is accommodated without too much trouble.

However, it costs the railways much more to provide four months' service annually to coastal ports than it does on a year-round basis, and the logical result is the use of seasonal railway rates. The rates for the Seaway open season reflect the cost of year-round railway service and the rates for the winter season are higher, reflecting the added cost of seasonal service. However, this presents a difficult problem for the U. S. railways, because they cannot distinguish between seasonal and non-seasonal customers as can the Canadian railways with their agreed charge arrangements.

The basic advantage of the Seaway is that the line haul costs of moving large volumes of cargo by water are in the order of one-quarter of the cost by rail. For instance, the proposed railway trainload grain

rate from Chicago to the U. S. North Atlantic ports implies an incremental rate of about four mills per ton mile. The incremental cost of a twenty-five thousand ton laker implied in the actual rates charged is about one mill per ton mile. The most optimistic estimate made in the railway industry is that the incremental railway costs may be reduced to as low as two mills with the use of both new integral train equipment and the most efficient operating procedures. This compares with about one-half a mill for a twenty-five ton laker on open water. Both figures are probably optimistic, but they still indicate a clear advantage for the water route on line haul basis. In bulk haul movements ships have a further advantage in loading and unloading efficiency and some of the large self-loaders and unloaders can move a cargo in less than five hours which means that, under suitable conditions, they spend most of their time under way.

An additional major advantage of the Seaway is that the downbound traffic is closely balanced by the upbound traffic; this is particularly important in bulk cargo movements, where Labroador-Quebec ore fills the big carriers going in the upbound direction and grain fills them in the downbound direction. If the potash trade develops as anticipated it will add downbound traffic that could nicely balance some of the potential growth in upbound iron ore traffic.

Shipping service on the Seaway and at Great Lakes ports has very good prospects of continuing to improve its operating and cost efficiency. While the average revenue cargo tonnage per vessel transit has more than doubled since the Seaway opened, it is possible for it to double again as more ships for ocean, laker and combined ocean-laker service are built to the maximum size permitted by the canal lock dimensions. Harbour facilities and channels are being continually improved and there is a fairly steady growth and development of the necessary ancillary services. Another area of major importance is in the planning of ship operations in order to make the maximum use of ship capabilities, and in the planning of harbour and lock operations to facilitate improved turn-around times; there is considerable room for improvement in all of these areas.

Tbe greatest problems face ships in trans-ocean service, since they depend as much on improvements in overseas harbour operations as they do on the improvements at North American harbours. The strong growth in world trade and the need of overseas countries to maintain their economic competitiveness in world markets guarantee that these improvements will be made.

As improvements in the turn-around times in harbours at both ends of overseas trade routes are made, differences in travel times and distances for vessels on these routes will become relatively more

important than they are now and this development could work to the disadvantage of the Seaway. Chicago, for instance, is about 20% farther from Antwerp than New York in distance and in the order of 25% to 30% farther in navigation time. Newer ocean vessels are also faster and, as in-harbour operations speed up, the incentive to increase the speed of ships on the high seas will increase also. However, the speed of ships navigating the Seaway is partly limited by the narrowness of many river and canal channels and, of course, by the lockage operations of the Seaway. It is probable that a trip to Chicago will take in the order of 30% to 40% longer from Antwerp than to New York for fast ocean cargo vessels. Currently, the time spent in harbours is as much as, and often more than, the time spent under way; this makes the total turn-around time differential to Chicago normally only 10% to 15% longer than to New York. As in-harbour time decreases and the speed on the high seas increases, the differential in total turn-around time between Antwerp - New York and Antwerp - Chicago may be as much as 20% to 30%. However, it is probable that total rates will decrease at the same time, and the differential for service to inland points may decline in total, though it increase relatively. An additional factor is that the larger ocean vessels can only make the fullest use of their capacity by topping off or unloading additional cargo when they reach Montreal or other ports below the Seaway where they can use their full draft.

The main future consideration is whether the differential in cost of ships using the Seaway versus Atlantic ports in overseas trade is still competitive with overland railway movement to and from those Atlantic ports. There is now abundant evidence that the railways in North America are well on their way to making substantial improvements in efficiency of operations and part of this process includes a rationalization of rate structures to reflect the underlying costs of providing railway services more accurately than they do at present. Currently, there are many instances where railway rates from inland points to the Atlantic and Gulf ports in the U.S. and to the Lower Seaway and Maritime ports in Canada are substantially lower on a mileage basis than they are to Great Lakes ports. In the United States, in particular, there are strong pressures developing to bring rates more in line with distance and this pressure is already showing results with the recent change in rates for grain into Chicago. Ultimately, distance alone is not an adequate basis for rate rationalization because it does not reflect the relative efficiency of operations one route may afford over another by virtue of its traffic balance and the amount of traffic it feeds to other routes. Nonetheless, the old rate structures are still so far out of line that there is considerable room for restructuring in favour of the Seaway.

Another factor of major importance on the U.S. side of the Seaway

is the pattern of railway ownership developing as the result of recent mergers; it appears likely that there will eventually be only two or three railways in the north eastern part of the United States from Chicago to the Atlantic ports. This development exposes the railways in this area to government regulation against discrimination between Great Lakes and Atlantic ports. It also, of course, opens up new opportunities for improvements in operations and consolidation of large-scale trainload movements.

The development of the train load concept in terms of special rates, special operating procedures and, most recently, special equipment (articulated cars), is a dramatic illustration of the changes taking place in transportation. These developments make the railways potentially far more competitive with water movement when train load volumes can be assembled. The most recent example of this development is a proposal for seasonal train load grain rates from Chicago to the U. S. north eastern seaboard ports of $4.00 per ton; this rate, coupled with the new rates into Chicago, would offer close competition with present direct shipping from that area. However, this is the Chicago area only, and much of the attraction of that area for ships is that it offers a wide range of agricultural products for direct shipping overseas.

On balance, the Seaway route appears to have as much possibility of improvement from the point of efficiency and economy of operations as the competing railway service to the North American Great Lakes hinterland. The weight of investment commitments to both systems and the vested interests of many regions and businesses are persuasive arguments for the maintenance of the competitiveness of the Seaway route. Furthermore, it is a recognized economic and political fact that a major contribution of the Seaway is its competitive stimulus to improvement of the whole North American transportation system. It is only possible to conjecture the magnitude of this influence but, if a small share of the value of some of the improvements taking place in railway operations along can be attributed to the Seaway, a substantial portion of the original investment has been paid for by now.

10.0 THE STRUCTURE OF THE TOLL RATES

With strong prospects for continued future growth in Seaway commodity traffic tonnage, the ultimate capacity limit of the Seaway becomes a problem of paramount importance. The sooner that new Seaway facilities have to be added, the greater the toll rate increase necessary to meet the added financial and operating costs. There is a definite possibility that the increase in tolls required to meet substantial new additions to Seaway capacity in the near future would interfere with the growth of Seaway commodity traffic enough to make the added capacity unnecessary.

If present facilities can be made to accommodate sufficient future Seaway traffic growth the toll rates required in respect of both present and future financial commitments should not interfere with this growth.

The time when new facilities or additions to present facilities will be required is dependent on both :-

- the growth in commodity traffic volume and
- the efficiency of Seaway lockage capacity utilization.

The efficiency of capacity utilization is dependent on the sizes of ships using the Seaway, the degree to which these ships are fully loaded for each transit, and the efficiency of the lockage operations.

In 1964, out of 6,272 cargo vessel transits of the Lower Seaway, 2,733

were made by ships of less than four hundred feet in length. Even when these smaller vessels transit the Seaway in tandem lockages they carry, on the average, one third the cargo tonnage of the largest vessels in single transit. The lockage time required for the two small vessels is about the same as required for the largest vessel. It is obvious that the size composition of the ships that use the Seaway makes a very great difference in the amount of cargo which can be handled in a season (see also Appendix C).

Another factor which has a considerable influence on the cargo tonnage capacity of the Seaway is the amount of Seaway lockage capacity used to handle empty ships. Whenever a ship manages a loaded transit in both directions it is effectively carrying about twice as much cargo for the same amount of lockage capacity utilized.

With the present toll schedule, about 92% of toll revenue payments are based on cargo carried and the remaining 8% on gross registered tonnage. In no way do the toll payments reflect the amount of Seaway capacity utilized.

For example, toll revenue per cargo vessels transit on the Montreal-Lake Ontario Section of the Seaway ranges from over twelve thousand dollars for a full seven-hundred-and-thirty foot vessel to under one hundred dollars for small vessels in ballast. Even assuming that the smaller ships always transit two-by-two, the ratio is twelve thousand dollars to two hundred

dollars, or sixty to one. Leaving out all vessels below two hundred feet in length and assuming tandem lockages for the smaller vessels, the ratio is still six to one. The canal capacity utilized by two small vessels in tandem is about the same as the capacity utilized by the largest vessels capable of navigating the Seaway. The graph on the following page shows the percentage each size class of ship contributed in 1964 to the cargo carried, the revenue collected, and the lockage time utilized on the Montreal-Lake Ontario Section of the Seaway.

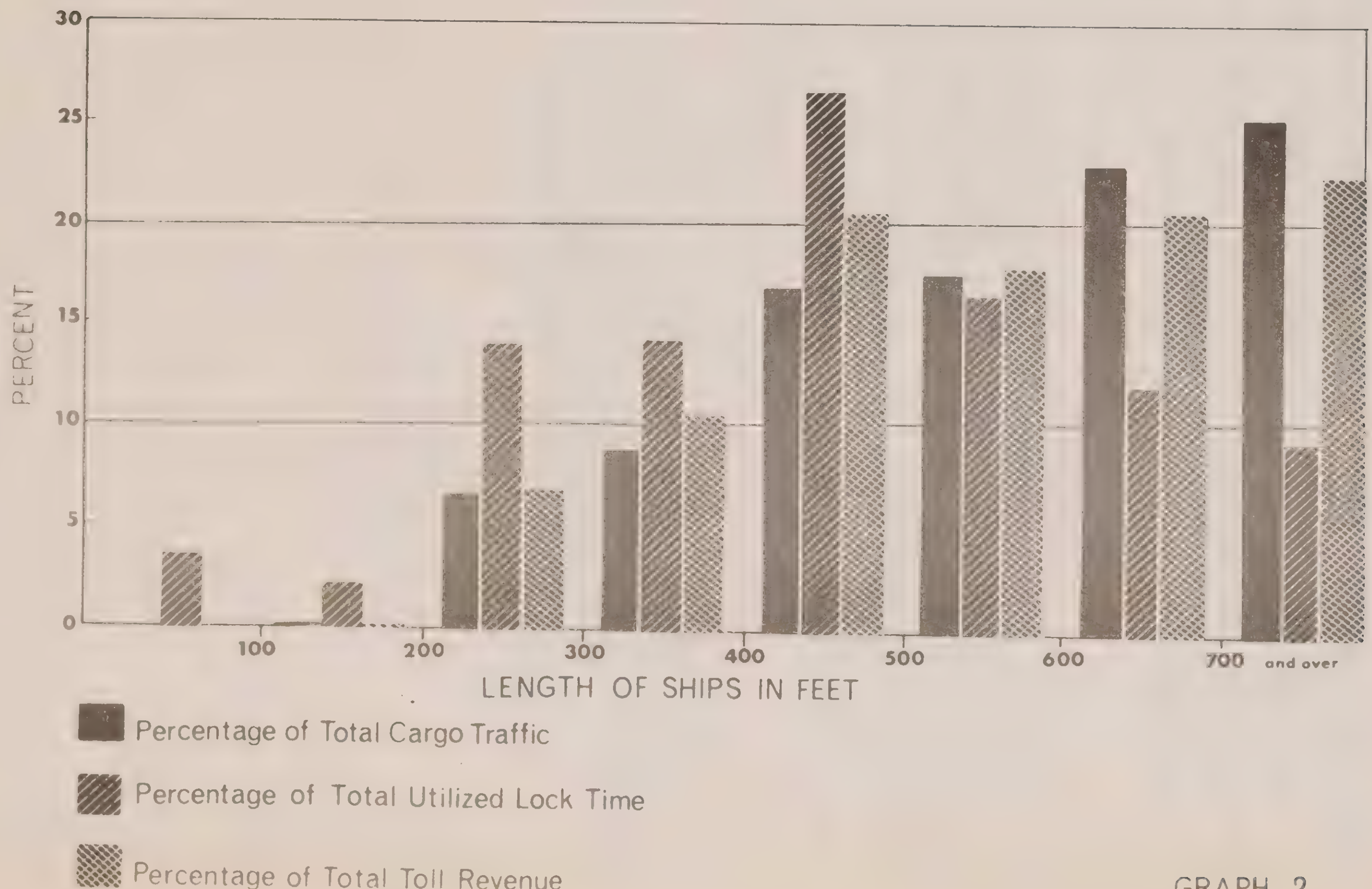
Under conditions in which the Seaway is operating with transit capacity to spare, the present toll structure creates no particular problem. In fact, it was probably the best approach to use during the early period of transition to the new standards of size allowed by the larger locks. However, this toll structure provides no incentive to ship operators to make efficient use of the Seaway facilities. Under present traffic growth and operating conditions, the toll structure should provide some incentive to Seaway users toward making the most efficient use of present facilities that is economically and technically feasible.

It is important to note that there will probably not be much more than a ten million ton difference in the load on the two sections of the Seaway by about 1967. Taking other factors into consideration, such as the type of ships carrying the extra cargo on the Welland, the balance of traffic and the length of seasons, it is likely that the capacity limit on the Montreal-Lake

TRAFFIC PERFORMANCE BY SIZE OF SHIP

MONTREAL - LAKE ONTARIO SECTION

1964 SEASON



GRAPH 2

Ontario Section of the Seaway may be reached within a few years of the time it is reached on the Welland. In any event, the two Sections are interdependent in respect of the size composition of the ship fleet and the traffic levels: any policy which benefits one Section of the Seaway benefits both Sections.

A toll structure which would reward efficiency of canal capacity utilization would have the added effect of promoting efficiency throughout the Seaway, in harbour operations and in ship capacity utilization. This would mean giving the Seaway the best possible chance to remain competitive with other modes of transportation.

The change in toll structure which would have the desired tendency would be to tie part of the toll to the canal capacity utilized. The following section examines the possibility and effects of such a tolls policy.

11.0 TOLL RATE REQUIREMENTS BASED ON A RATE STRUCTURE CHANGED TO REFLECT SEAWAY CAPACITY UTILIZED

11.1 Tolls Based on Capacity Utilization Only

If the Seaway tolls were based entirely on the proportion of capacity utilized, tolls would be levied on the basis of lockage operating time used by a ship in transit through the canal. The change this would have on the incidence of tolls by ship size can be illustrated by looking at the tolls that would have been paid on this basis in 1964 to collect the same amount of revenue and Table 5 shows such a comparison.

The major point to note is that, for all ships under five hundred feet in length, such a toll system would involve increased payments without increasing total revenues. Conversely, all ships over five hundred feet in length would pay less toll revenue.

TABLE 5 COMPARISON OF TOLLS PAID BY SHIP SIZE ON BASIS OF PRESENT TOLL STRUCTURE AND TOLLS BASED ON CANAL CAPACITY UTILIZED - 1964 Traffic Performance

Ship Classification	Actual tolls paid in 1964 per transit	Tolls paid on basis of canal capacity used	Percent change
	$	$	%
Ships in tandem lockages	1,543	2,000*	+ 30
Ships 0-499 ft. in single lockages	1,543	3,433	+ 123
500-599 ft.	3,883	3,684	- 5
600-699 ft.	6,476	3,684	- 43
700 ft. +	10,372	4,353	- 58
Total (000s)	19,085	19,085	- 0

*Assuming 1964 operating standards and the maximum number of tandem lockages which would be feasible

The actual effect on very small ships is even greater than indicated. Obviously such a switch in toll policy would be very disrupting; it would also have an added disadvantage in that it would require effectively higher tolls per ton of cargo traffic in the early years of traffic growth and lower rates as ship sizes increased. Up to a point, this could be desirable because of the prospect of increasing competition for traffic from other modes. However, in principle, it would be better to let the growth in future traffic tonnage bear a more proportionate share of the cost of the Seaway.

11.2 Tolls Based Partly on Capacity Utilization

A per lockage fee added to the present tolls would have the effect of basing part of the toll incidence on capacity utilized. If this toll is shared by ships in the same lockage, it would encourage the arrangement of multiple lockages for small ships. At present, tandem lockages are formed only when two small ships happen to be in a line-up. However, with suitable encouragement the operators of these small ships would arrange schedules so that they could make tandem passages of the canal system nearly all the time.

An analysis has been made of this small ship (under four hundred feet in length) traffic and is summarized in Appendix D. It was found that roughly half the traffic could be carried in larger vessels. It is likely that

a considerable portion of the balance will move to larger vessels as harbour and ship transfer facilities are improved. In fact, there does not appear to be a significantly large portion of small ship traffic which cannot ultimately be accommodated in larger vessels.

A toll based on capacity utilization would, no doubt, encourage better use of the present Seaway facilities, yet the response to such a policy will necessarily take time; new ships have to be brought into service and management practices will have to be adapted. In order to minimize the initial impact of the per lockage fee, it should be phased in gradually.

In line with this program, the present toll on gross registered tonnage should be dropped and this would reduce the impact of the per lockage fee on the largest vessels more than it would for the smaller ones. This is fair, since the large vessel operations already pay a disproportionate share of the tolls. It is also very desirable because it is the upbound movement of iron ore that is in the greatest danger of some diversion due to toll increases. Should the traffic be lost, Seaway ship traffic demand would not be reduced accordingly because it is determined mainly by the downbound volume of cargo such as grain. Yet the loss of any iron ore traffic would ultimately mean a much greater increase in the cost of moving grain and other products, such as potash, downbound. This is because, of course, the downbound grain and the upbound iron ore fill the same ships a good part of the time and the loss of this efficiency could be greater than the entire impact of present tolls on the grain traffic.

Regarding the principle of a per lockage fee, two points might be made by way of summary. Firstly, it must be understood that the per lockage toll should be phased in over a five-year period; this would be essential in order to give the shipping industry time enough to plan and respond to the incentive. Secondly such a change in tolls should be looked on as a very concrete statement of policy which, in itself, should help to encourage the development of a more rational dialogue among the various parties who have contending views on the Seaway.

APPENDIX A

Summary of Traffic Forecasts

APPENDIX A

SUMMARY OF ST. LAWRENCE SEAWAY TRAFFIC FORECASTS, 1965 - 2009

Basic Assumptions, JKA Forecasts

The following are the main assumptions which have been used in making the basic or best estimate forecasts to 1980 :-

No sudden and radical change in the relative economics of the Seaway route.

Continuation of present trends in general economic activity in both the U.S.A. and Canada.

No radical change in the international trade relations of the U.S.A. and Canada.

No extreme adverse weather conditions seriously affecting grain production in North America for more than one year at a time.

No major change in U.S.A. and Canadian policies in respect of their waterborne commerce.

Continuation of general economic growth trends in Western and Eastern Europe.

No change in tolls on the St. Lawrence Seaway greater than + or - 20% with the present toll structure.

The most important assumption in the forecasting is that there will be no radical change in the relative economics of the Seaway route. Events and portents in transportation in North America all point to dramatic changes in the economy and service of commodity transportation. If attention is confined only to the railway or only to the waterways, it is easy to arrive at the conclusion that the one given close attention will leave the other far behind. However, after careful consideration of all major factors, it appears that the balance of advantage, insofar as the

Seaway route is concerned, will not be altered drastically within the next fifteen years.

This can be expressed another way by saying that it appears quite feasible that ship operations on the Seaway can make further technological and operational improvements in order to match the improvements in rates and services which the railways are beginning to implement. It must be acknowledged that the pace of these developments is so much greater than anything experienced in the past and that industry is learning to attach so much more significance to economies in transportation than previously that this conclusion of a draw is one which must be held sceptically and should be continually reviewed.

One other major reason for concluding that the overall balance of advantage of the Seaway route will not be altered too drastically is the recognition in industry and government that many of the developments in railway transportation would not have taken place as soon as they did, or at all, if it had not been for the competitive threat of the Seaway. With a large political and economic investment now committed to the Seaway, the same competitive pressures apply to the Seaway whenever railway developments seriously threaten Seaway traffic.

The Method in Broad Outline

The major commodity components of Seaway traffic have been forecast to 1980 on the basis of an economic analysis of the production and demand factors which generate the trade, together with an analysis of the transportation factors which determine the routing of the trade.

In consideration of the grain traffic, the main factors on the demand side are the prospective food surpluses and deficiencies in overseas countries. On the supply side, the main factor in the Canadian trade is the production potential of the prairie region. The main consideration with the U.S. grain trade through the Seaway is not the supply factors but the competition for transporting the grain to the major port outlets.

In consideration of the iron ore traffic, the main factors used in the forecast to 1980 were the estimates of total North American demand for iron and steel production, and, on the supply side, the investment commitments and expressed intentions and the potentials of the major sources of iron ore supply. An additional and important factor is the indication that the Quebec-Labrador ores have a marked advantage in their low silica content and greater suitability for beneficiation.

The main factors taken into account in forecasting potash traffic are the investment commitments in production facilities, the potential volumes and quantities of production, and the overseas market potential for potash.

General cargo was forecast in the aggregate after a study of the pattern of development of its main components. This forecast comprised mainly two forecasts, first the trend of the general cargo trade in tons of the Great Lakes hinterland and, secondly, the growth and limit to the share of this trade which would be routed through the Seaway. The general cargo forecast was based on a broader definition than used for tolls assessment purposes. The definition used is more

consistent with the handling and value characteristics of general cargo. The general cargo by tolls definition was then calculated as a constant percentage share of the broader classification.

Coal and coke, and petroleum products traffic was forecast on the basis of continuation of present government policies respecting the markets for these commodities and on marketing and traffic trend patterns.

Most of the remaining components of the Seaway traffic were forecast on the basis of their actual traffic trends modified in some instances by market considerations.

No attempt was made to forecast traffic much beyond 1980. Instead, the trend in volume was extrapolated on the basis of growth rates. These growth rates were based partly on the historical trends in cargo tonnage trade volumes of the U. S. and Canada and partly on trends of economic indications in general in Canada and the U. S. The resulting projections were reviewed to see if the volumes implied were reasonable in relation to foreseeable resource limitations. With the speed of technological development today and the possibilities inherent in resource findings such as the potash of Western Canada, we concluded that the projections are technically possible. On this basis of historical trends the projected trends are conservative.

High and Low Forecasts

There is a considerable degree of uncertainty about these forecasts and this is expressed by a high and a low forecast which reflect the reasonable extremes of this uncertainty. The range of uncertainty is

greater on the high side, for these reasons :-

1. The share of U.S.A. grain export shipments routed through the Seaway could increase considerably more than anticipated. At present, it is estimated that only about 25% of the grain exported from the region tributary to the Great Lakes actually is routed via the Seaway.

2. A similar situation holds with the general cargo trade of the U.S.A. and overseas countries. It is estimated that the current share of this trade, routed via the Seaway, is between 15% and 20% of the total trade of the U.S.A. Great Lakes hinterland.

3. The iron ore demands of both Canada and the U.S.A. would have to be revised upwards if the recent trends in industrial production and construction become established patterns.

4. The Russian wheat sales have been dealt with as "one shot deals". If they become an established pattern, they would increase the near term grain volume forecast for the Seaway.

5. A fairly rapid buildup of an ocean laker fleet capable of taking inland products directly overseas could lead to a more rapid development of the Seaway route. (This was expected by the Commission on Coasting Trade and it did not develop as rapidly as anticipated.)

The range of uncertainty on the low side is due to the following :-

1. In the "best estimate" forecast, it has been estimated that the potash movement, via the Seaway, will be 8.3 million tons by 1980. The potash industry is not prepared to commit itself yet to routes or volume estimates. Our forecast is based almost entirely on our own assessment of the likely directions and volumes that the trade in this commodity will follow. The same problems exist with estimating this commodity movement in estimating the iron ore traffic which would develop before the Seaway was opened. It is always much easier to deal with established patterns of trade volumes and trade routes.

2. The Canadian grain trade routing could swing more to the West coast ports than estimated in our basic forecasts. We could also lose some ground in the volume of this trade to the U.S.A. and part of this loss could take non-Seaway routes. Also, of course, Common Market developments in Europe could work to the disadvantage of this trade.

3. In addition to the level of iron and steel production, the iron ore requirements of the North American iron and steel producing industries depend on the iron content of the ore and the amount of scrap used. The shipped ore is becoming rapidly standardized to a level between 65% and 70% iron content through processes of beneficiation and pelletization. However, still in the experimental stages, ore processed for direct reduction would raise the iron content to 90% or higher. It requires only about 72% of 90% ore to produce as much steel as 65% ore. Currently new methods of processing iron into steel have been making less use of scrap iron. However, the rate of consumer scrap accumulation is likely to force some price adjustment that would cause an increase in the amount of scrap utilized. Another consideration is, that for aesthetic reasons, government measures may be undertaken to induce fuller utilization of consumer (automobile) type scrap.

4. The amount of North American steel industry ore requirements supplied by the Quebec-Labrador mines and routed through the Seaway is subject to considerations which are not directly related to the economics of the Seaway route. Such considerations are the result of strategic political and financial manoeurvres involving both foreign and domestic situations. The integrated nature of the industry makes it possible to carry out such strategies. It is conceivable that circumstances could arise where any or all of the following policies might be invoked for a period of time.

(a) Go-slow procedure for expansion of the Quebec-Labrador fields to induce more favourable government policies.

(b) Diversion of more of the Quebec-Labrador ore into foreign markets in order to establish overseas market shares and/or obtain more favourable government policies respecting other overseas ore developments.

(c) Diversion of more of the Quebec-Labrador ore through the Atlantic Coast ports in order to put pressure for the development of inland waterways and/or protest toll increases. Such diversions might nominally cost much more than the toll increases that might be in question.

5. An acceleration of developments in railway transportation technology, operations management and pricing of services could overtake some of the developments taking place in favour of the Seaway route. If this happened, it could slow the growth in the Seaway route.

It should be noted that, with the exception of the forecast for 1965, all the forecasts are trend forecasts. In any particular year there may be short term influences which would cause a temporary increase or decrease in traffic. Currently, the large inflow of foreign steel and Russian wheat sales have boosted traffic, while the U.K. surcharges on imports has contributed to a slightly reduced downbound volume of general cargo Seaway traffic. However, these conditions are considered to be of a short-term nature.

Bulk and General Cargo Composition of Forecasts

The relative amount of bulk and general cargo is expected to remain approximately the same as in 1964, that is, approximately 9.5% general and 90.5% bulk. This means that an average toll rate on cargo can be used in the toll calculations.

Stanford Research Institute Seaway Traffic Forecasts

The SRI forecasts are included in Table A1. It is anticipated that the final forecasts used by the Canadian and U.S. Tolls Committees jointly will be a compromise between the JKA and SRI forecasts.

Table A2 compares the main components of the two forecasts. This comparison is based on the medium or best estimate JKA forecast and the average of the SRI high and low forecasts for 1980.

The main differences are due to the expectation in the JKA forecasts

of a much greater volume of Canadian wheat, iron ore and potash moving through the Seaway.

TABLE A1 ST. LAWRENCE SEAWAY TRAFFIC

ACTUAL TO 1964 - FORECAST TO 1980

PROJECTED TO 2010

	Actual
1959	20.6
1960	20.3
1961	23.4
1962	25.6
1963	30.9
1964	39.3

Forecast	JKA Forecast			SRI Forecast	
	Low	Medium	High	Low	High
1965	43.6	43.6	43.6	41.3	45.7
1966	42.8	44.8	48.5	41.6	46.6
1967	44.1	46.1	52.0	41.9	47.5
1968	47.0	49.0	56.6	42.2	48.4
1969	49.7	51.7	60.6	42.5	49.3
1970	51.8	55.0	64.5	42.8	50.2
1971	53.0	56.7	68.3	43.7	51.9
1972	54.3	58.7	71.7	44.6	53.6
1973	55.7	60.9	75.0	45.5	55.3
1974	57.2	62.6	78.3	46.4	57.0
1975	58.2	64.8	81.3	47.5	58.7
1976	59.3	67.1	84.5	48.5	60.1
1977	60.5	69.1	87.0	49.5	61.5
1978	61.6	70.8	89.0	50.5	62.9
1979	62.6	72.8	91.0	51.5	64.3
1980	63.6	74.6	93.0	52.4	65.9
Projected					
1990	74.0	96.8	117.8	57.4	72.9
2000	83.1	118.1	139.1	62.4	89.9
2010	93.0	143.9	164.9	68.4	102.1

TABLE A2

COMPARISON OF SRI AND JKA FORECASTS
- millions of short tons -

1980

	SRI Average of High and Low	JKA Medium Range Forecast	Difference Tons	JKA-SRI %
Iron	22.0	26.0	+ 4.0	+ 18
Coal and Coke	1.4	1.5	+ .1	+ 7
Petroleum	2.4	2.6	+ .2	+ 8
Wheat	5.4	9.8	+ 4.4	+ 82
Other grain	12.1	11.4	- .7	- 6
Potash	2.1 *	8.3	+ 6.2	+295
General cargo	6.1	7.3	+ 1.2	+ 20
Other bulk	7.7	7.7	-	-
	59.2	74.6	15.4	+ 26

* See SRI p. 8-6; the SRI study appears to arrive at a figure of 7.7 for other bulk not including potash, which would mean that potash movement is estimated to amount to 2,100,000 tons by 1980.

TABLE A3

ST. LAWRENCE SEAWAY TRAFFIC GROWTH RATES

Actual Year to Year Growth (per cent)

1959-60	- 1.5
1960-61	+15.3
1961-62	+ 9.4
1962-63	+20.7
1963-64	+27.2

COMPOUND GROWTH RATES OF FORECASTS

	JKA Forecast			SRI Forecast	
	Low	Medium	High	Low	High
	+	+	+	+	+
1964-65	10.9	10.9	10.9	5.1	16.3
1964-70	4.7	5.8	8.6	1.4	4.2
1970-75	2.4	3.3	4.7	2.1	3.2
1975-80	1.8	2.9	2.7	2.0	2.4
1980-2000	1.4	2.3	2.0	0.8	1.6

APPENDIX B

Method and Basis of Calculating Toll Requirements

APPENDIX B

THE METHOD AND BASIS OF CALCULATING CANADIAN TOLL REQUIREMENTS

Introduction

These financial obligations consist of all costs of operating and maintaining the Canadian toll locks of the lower Seaway section, including an appropriate share of head office administration costs and amortization of the capital costs including interest by the year 2009. Data on the Seaway debt and operating and maintenance costs, including a forecast of the latter, has been obtained from Mr. J.M. Martin, Director of Finance and Accounting for the St. Lawrence Seaway Authority.

Statutory Debt

As of December 31st the loans outstanding with respect to the Montreal-Lake Ontario section of the Seaway and deferred interest were as follows :-

Loans	$318,146,000
Deferred interest	35,348,642
Total statutory debt	$353,494,642

The average interest rate on this debt is 4.391%. This rate would not rise appreciably unless a considerable increase in deferred interest were anticipated. However, the tolls are being calculated to meet the statutory requirements and in all the cases analysed only a fairly small further accumulation of deferred interest would occur before the calculated toll rate would result in revenues that cover current interest. Since the current interest on prime Canadian government securities sold in Canada or the

United States is effectively higher than 4.391% and is most likely to remain this way, there is little likelihood of the possibility of refinancing the Seaway debt in order to reduce the interest cost. The calculation of toll requirements is therefore based on an interest rate on debt of 4.391%.

The statutory debt of the Welland Canal is currently $41,000,000, which is interest-free until 1972. All other past capital expenditures have been written off.

Operating and Maintenance Costs

These expenses rose from 2.5 million dollars in 1960, the first full year of operation of the lower Seaway, to 3.8 million dollars in 1964. On the Welland Canal they rose from 4.1 million dollars in 1960 to 6.7 million dollars in 1964. A provision for replacement of machinery and equipment is included in these costs and a share of the head office administration based on the proportions of total payroll expenses of the divisions.

The rise in operating costs is due largly to increases in wage and salary rates which have to be maintained at levels commensurate with trends in employment in the economy at large. Part of the increase since 1960 was due to a policy of providing year round employment where seasonal employment of operating and maintenance personnel had once been the custom; Today operating personnel do maintenance on the canal in the off season.

It is anticipated that the trend in operating costs will continue to rise, but not so rapidly as in the past. In general, it can be said that the projected rise in operating costs will be more or less consistent with rising labour costs which all industry experiences as income per capita rises.

Automation of various aspects of canal operations and maintenance could and may be used to improve labour productivity.

Partly because of the uncertainty of the long term trend in these costs they are projected on trend only to 1977 and thence left at a constant level. Another and more compelling reason for not projecting these costs beyond 1977 is that to do so would be tantamount to predicating present toll requirements partly on future inflation in operating costs. Such increases in statutory financial requirements are properly covered by future adjustments in tolls. It must be emphasized therefore that the toll requirements we have calculated do not cover increases in operating and maintenance costs beyond 1977. These costs should be reviewed at least every five years to determine whether their trend requires an appropriate toll adjustment.

The following are the operating maintenance costs, including a provision for equipment replacement, which have been used to calculate toll requirements given various forecasts of commodity traffic :-

Projected Operating and Maintenance Costs of the Seaway Including Provision for Equipment Replacement

	Montreal-Lake Ontario	Welland Canal
	$	$
1965	4,150,000	5,500,000
1966	4,300,000	5,900,000
1967	4,475,000	6,200,000
1968	4,650,000	6,400,000
1969	4,825,000	6,600,000
1970	4,960,000	6,800,000
1971	5,090,000	7,000,000
1972	5,220,000	7,200,000
1973	5,350,000	7,400,000
1974	5,480,000	7,600,000
1975	5,615,000	7,800,000
1976	5,745,000	8,000,000
1977	5,890,000	8,200,000
1978 to 2009	5,890,000	8,200,000

Average Toll Rate per Cargo Ton, Montreal-Lake Ontario Section

Since changes in the share of cargo traffic which is general cargo (toll definition) and in the amount of in-ballast traffic do occur, the average toll rate varies considerably year to year.

	Average Toll Revenue Collected per Cargo Ton of Traffic
	$
1959	.486
1960	.489
1961	.491
1962	.487
1963	.498
1964	.486
1965	.507 estimated
1966 +	.486 if toll level and structure unchanged

Average toll per bulk cargo ton and per general cargo ton have not varied so much; they amount to approximately $.426 per ton of bulk cargo and $.982 per ton of general cargo, including the toll on GRT. In addition, traffic in ballast adds $.008 per ton of cargo. The average toll rate for 1965 is based on the large increase in general cargo share over previous years (13.3% in 1965 versus 9.4% in 1964).

The forecasts which have been made of cargo traffic volume indicate that the share of general cargo traffic is not likely to change very much from what it was in 1964, that is, about 9.5%. Therefore it is assumed that, with the exception of 1965, the average toll rate will not change due to changes in general cargo share. The basic rate which is used is the 1964 rate, which was $.4855 per average cargo ton. The variations which we foresee that could arise are contained within the extreme forecasts which have been made.

APPENDIX C

A Memorandum on the Effect of Vessel Size on Seaway Capacity and Toll Requirements

APPENDIX C

A MEMORANDUM ON THE EFFECT OF VESSEL SIZE ON SEAWAY CAPACITY AND TOLL REQUIREMENTS

(Dr. J. Kates)

Other parts of the SLSA economic study have shown that Seaway traffic can be expected to increase steadily providing that the Seaway has the capacity to carry this extra traffic, and extensive calculations have been made to estimate Seaway capacity under various assumptions.

A report on the capacity calculations will be submitted shortly. The purpose of this memorandum is to illustrate, by simple examples, the effect of vessel size on Seaway capacity and the importance of accelerating the introduction of larger vessels into the Seaway trade.

Small vessels take up almost as much lockage time as large vessels. Therefore, the annual Seaway capacity depends very markedly on the mix of vessels using the Seaway, as illustrated in Figure 1.

Figure 1 shows that if all vessels were between 300 feet and 399 feet the annual Seaway capacity would be limited to approximately 27.2 million tons (tandems have been ignored)* while, if all vessels were over 700 feet, the annual capacity would be approximately five times as large or about 130 million tons. Since larger vessels make possible larger Seaway capacity they would require lower per-ton tolls to support the Seaway; this is illustrated in Table 1 which shows the approximate per-ton tolls which would be required to meet the SLSA obligations for the lower Seaway section.

TABLE 1

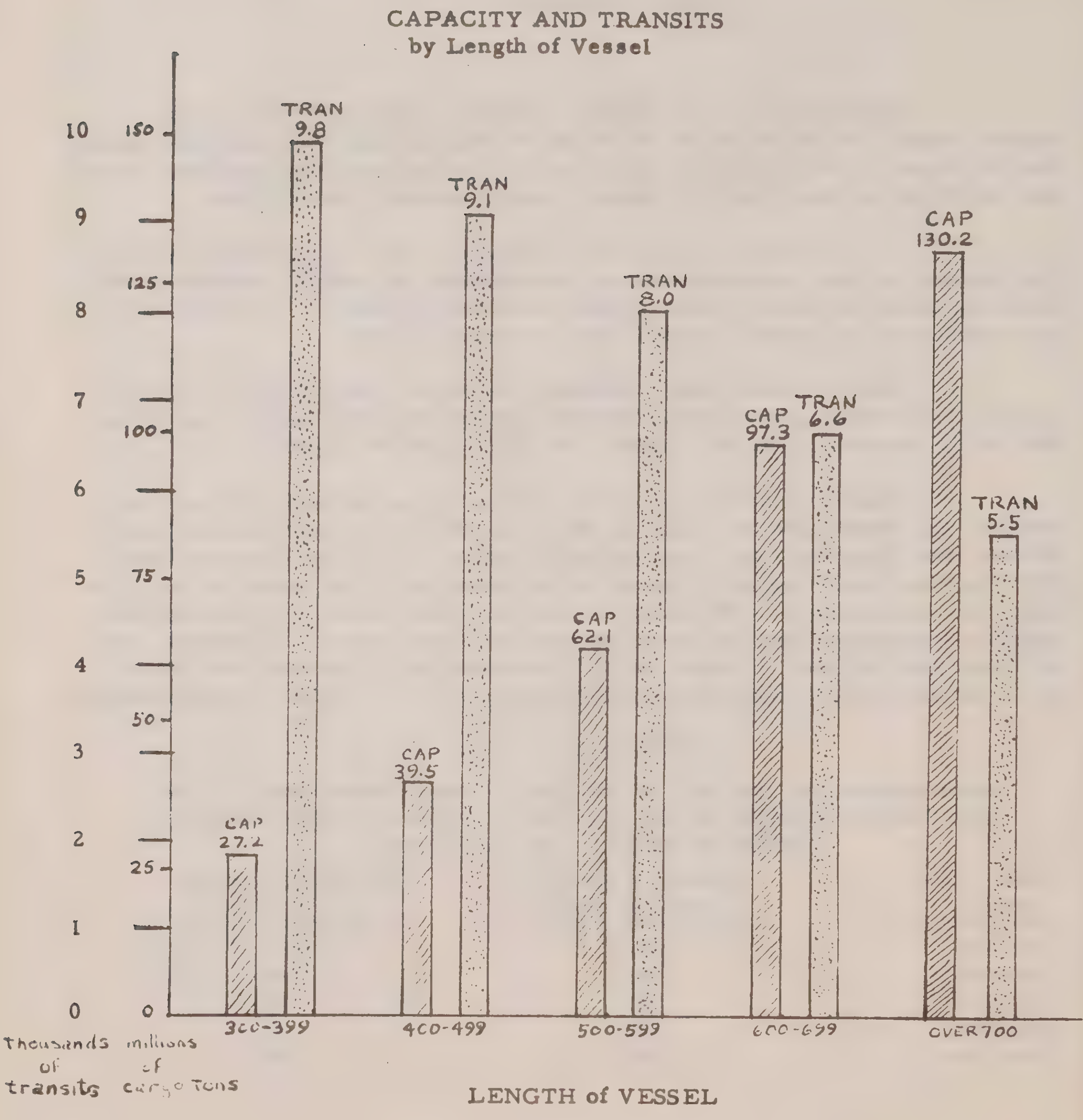
Approximate per-ton tolls in relation to vessel size based on the JKA Medium Growth Traffic Forecast. (Montreal-Lake Ontario, Balanced Traffic. No Tandems)

Vessel Size (Feet)	Annual Capacity (Million Tons)	Toll Requirements (C/Ton)
300-399	27.2	129
400-499	39.5	89
500-599	62.1	60
600-699	97.3	46
Over 700	130.2	44

* This means that the capacity with small ships only may be understated by 20% or so, but the capacity using larger ships would not be affected significantly.

FIGURE I

Approximate annual capacity and transits in relation to size of carrier (Balanced Traffic)



The foregoing Table shows that, if all vessels were of the 300 foot to 399 foot length, Seaway tolls would have to be increased 2.6 times over the present toll rate. If all vessels were of maximum size, the toll rate on the Montreal-Lake Ontario section could actually be reduced by 10%.

Since the mix of vessel sizes using the Seaway governs the maximum capacity, it also governs how soon additional investments are required to increase capacity.

Table 2 (based on present forecasts) shows approximately which year major additional capacity will be required, depending on the vessel size.

TABLE 2

Vessel Size	Year New Capacity Required
300-399	1963
400-499	1965
500-599	1975
600-699	1990
Over 700	2005

The foregoing dramatically illustrates that if the length of all vessels were 300 feet to 399 feet, not only would tolls on the lower section have to be increased 2.6 times to pay for the present Seaway, but large additional capacity would have had to be provided by 1963, probably doubling the Seaway debt. On the other hand, if the Seaway were used only by the largest carriers, tolls could be decreased by 10%, and additional capacity would probably not be required until the next century.

These are, of course, extreme examples, but they show dramatically how important average vessel mix is to the financial and construction planning of the Seaway Authority.

Any policy which accelerates the use of the Seaway by larger carriers will substantially increase potential revenues for use of the present system and delay the time by which additional capacity must be provided and large additional indebtedness must be incurred. Such a policy will also make possible relatively low tolls on a per-ton basis.

It is not difficult to justify a policy favouring the larger carrier. In the first instance it costs the Authority almost as much to provide for a small as for a large carrier and if charges were based on costs incurred by the Authority, large carriers would be charged only slightly more in total per transit than small carriers. In other words, on a cost of service basis the per-ton tolls would reduce almost in proportion to the size of the carrier.

In the second instance, large carriers make possible lower tolls for small carriers than would be possible if the bigger vessels did not exist. For example, if half the carriers were of the 300 foot to 399 foot length and half over 700 foot size, the average per-ton toll required would be 50 cents, whereas if all carriers were of the small 300 foot to 399 foot size, the average toll would be $1.29, or almost 2.6 times as high. In other words, in this example the introduction of large carriers would make it possible to lower the tolls to 39% of the charges which would be required if these vessels did not exist.

Naturally, a change in toll structure intended to accelerate the introduction of large carriers should be introduced gradually over a five to ten year period, so as to allow industry to adjust its plans to take advantage of this new policy.

APPENDIX D

Study of Seaway Traffic in Vessels Under 400 ft. in Length

ANALYSIS OF SEAWAY TRAFFIC OF SHIPS OF UNDER 400 FEET IN LENGTH MONTREAL-LAKE ONTARIO SECTION, 1964 SEASON

INTRODUCTION :

This analysis is based on a recap of all the transits of all ships under 400 ft. through the Montreal-Lake Ontario Section of the Seaway in 1964 ; together with each transit a compilation was made of the cargo carried, its origin and destination, and its classification. This compilation was done under the able direction of Messrs. Sprung and Johnson of the Seaway Authority in Cornwall.

The detail was examined and compiled in as meaningful categories as possible and some field checks and discussions with people knowledgeable in the use of ship services were made.

Estimates were then made of the number of transits and vessels which are likely to be required for an indefinite period in service where only small ships are suitable.

D. 1 General Trends in Size of Ships Using Seaway

Table D2 shows the changes which took place in vessel transits between 1960 and 1964 by size and type of vessel. An increase of six hundred and three ocean vessel transits in the 400 ft. to 600 ft. length category largely offset the decline in transits of smaller ocean vessels and the net

decrease in laker and other vessel transits (see Table D1 at the end of this Appendix for the full details of vessel transits by year, 1960 to 1964).

The most spectacular change has occurred in the number of laker vessel transits of under three hundred feet; ships of this length accounted for over two thirds of the lake vessel traffic in 1960 and by 1964 they accounted for one third. These ships were mostly the "canallers" which were built for the old St. Lawrence locks which allowed a maximum draft of fourteen feet, a maximum length of two hundred and sixty feet and a beam of forty-four feet. Upon the opening of the new locks on the lower Seaway, a number of these vessels were lengthened to three hundred and fifty feet and refitted and this practice chiefly accounts for the increase in the number of laker ship transits in the three hundred to three hundred and ninety-nine feet category.

The rapid shift to larger vessels has been due to the following :-

(i) the greater economy of larger vessels *
(ii) adequate channel, lock docking, loading and unloading facilities
(iii) commodity traffic in sufficient volume.

A basic question about the future of this trend is the extent to which it is feasible to carry more of the remaining commodity traffic which now

---

* The economy of larger lake vessels has been partly due to Canadian Government provisions for fast writeoffs and the "angel plan" device. Government building subsidies mainly guaranteed that new vessels would be built in Canada.

moves in small ships, in larger ships instead. In order to try and answer this question, in part at least, an analysis of the 1964 lower Seaway commodity traffic by ship and by origin and destination has been made.

This analysis covers 48% of the commercial vessel transits of 1964 (lower Seaway), 13% of bulk cargo, 39% of general cargo. or 15% of total cargo movement. See Table D3.

D. 2 Seaway Traffic in Ships of Under 400 Feet in Length

One half of the laker transits, one third of the ocean transits and nearly all "other vessel" transits in 1964 were made by ships under four hundred feet in length; all newsprint and most petroleum product movements were handled by these vessels. Some of the vessels serve ports or docks such as in the old Lachine Canal, which cannot be reached by larger vessels. Most of the petroleum product marine terminals still served by ship were originally set up for the old canaller type vessel and these are still the only vessels that can serve them.

Without any inducement from tolls, many more of the old canaller vessels will become uneconomical to operate as crew wages increase and in the face of competition from railway and truck service and their number has declined by more than half aready since the Seaway opened.

Most of the ocean vessel operations involving small vessels parallel operations of larger vessels serving the trade between the main ports of

Europe and the Great Lakes. M st of these vessels tour several ports on either side of the Atlantic each time they make a round trip; their cargo is two thirds general and one third bulk, while the cargo of the larger ocean carriers is one quarter general and three quarters bulk. In total, the small ocean vessels carry about 30% of ocean general cargo and about 8% of bulk cargo.

The main reason that the smaller ocean vessels are able to operate is that the very high value general cargo which they carry afford high rates and this traffic between major ports is very vulnerable to diversion to larger mixed cargo ocean vessels and potentially to containerization. Probably very little of this traffic is strictly captive to small ships in the same sense that some laker traffic happens to be. The estimate that half of it will remain in small ships for some time to come, is based on the relative insensitivity of this traffic to Seaway tolls and the probability that the conversion of general cargo to larger ships will take place gradually.

The "other" commercial vessel transits through the lower locks have been declining; about 40% of those recorded are of a tourist passenger boat that uses only a lock or two. Under conditions where slack capacity exists in the system, this luxury can probably be afforded, but under conditions of full traffic load such traffic should be expected to pay its way if it uses the system. Most of this traffic is related to construction operations and, by its very nature, this traffic is captive to the Seaway route. However, there

appear to be a number of instances where quite frequent transits are made in ballast. This frequency would be cut down considerably, no doubt, by a more substantial minimum per lockage fee.

In all it has been estimated that about one half the present traffic in small vessels is likely to remain for a considerable time with these vessels. The remaining traffic will most likely go by larger vessel, although some may be captured by the railways. It seems quite plausible that, in the face of appreciable minimum charges for transit of a lock, the practice of lightening large Seaway vessels using the old canallers for this purpose would develop. In this way the economy of large vessels for use on the Seaway would be combined with the advantages of the small boats in harbours where access is restricted.

TABLE D1

ST. LAWRENCE SEAWAY: MONTREAL - LAKE ONTARIO SECTION. TOTAL NUMBER OF VESSEL TRANSITS BY TYPE AND LENGTH. 1960 - 1964

LAKER VESSELS	1960		1961		1962		1963		1964	
	#	%	#	%	#	%	#	%	#	%
0-99	174	4.4	94	2.3	36	1.0	84	2.2	1	*
100-199	166	4.2	114	2.7	88	2.5	123	3.2	119	3.1
200-299	2,400	61.1	2.155	51.8	1,557	43.7	1,281	33.8	1,136	30.1
300-399	418	10.7	638	15.4	667	18.7	647	17.1	657	17.4
400-499	347	8.8	448	10.8	430	12.1	430	11.4	449	11.9
500-599	124	3.2	259	6.2	227	6.4	368	9.7	375	9.9
600-699	204	5.2	274	6.6	306	8.6	470	12.4	613	16.2
700-+	94	2.4	175	4.2	250	7.0	387	10.2	430	11.4
TOTAL	3,927	100.	4,157	100.	3,561	100.	3,790	100.	3,780	100.

OCEAN VESSELS	1960 #	1960 %	1961 #	1961 %	1962 #	1962 %	1963 #	1963 %	1964 #	1964 %
100-199	20	.9	3	.1	1	*	1	*	-	-
200-299	568	25.9	471	21.9	413	18.0	284	13.8	262	10.5
300-399	566	25.8	537	25.0	544	23.6	512	25.0	565	22.6
400-499	611	27.8	830	38.6	943	41.0	940	45.8	1,116	44.8
500-599	432	19.6	310	14.4	387	16.8	300	14.6	530	21.3
600-699					14	.6	16	.8	19	.8
TOTAL	2,197	100.	2,151	100.	2,302	100.	2,053	100.	2,492	100.

OTHER COMMERCIAL VESSELS	1960 #	1960 %	1961 #	1961 %	1962 #	1962 %	1963 #	1963 %	1964 #	1964 %
0- 99	460	65.3	484	82.9	383	78.5	354	80.1	356	70.2
100-199	216	30.6	73	12.5	72	14.8	54	12.3	106	20.9
200-299	14	2.0	-	-	7	1.4	1	.2	20	3.9
300-399	10	1.4	10	1.7	9	1.8	16	3.6	15	3.0
400-499	1	.1	11	1.9	5	1.0	5	1.1	6	1.2
500-599	4	.6	6	1.0	12	2.5	11	2.5	4	.8
600-699	-	-	-	-	-	-	1	.2	-	-
TOTAL	705	100.	584	100.	488	100.	442	100.	507	100.

PLEASURE CRAFT	1960	1961	1962	1963	1964
	483	528	569	618	609

* Less than .5%

TABLE D2

Changes in Ship Transits Between 1960 and 1964
By Length and Type of Ship

Ship Length	Laker Vessels	Ocean Vessels	Other Vessels	All Vessels
0- 99	- 173	*	- 104	- 277
100-199	- 47	- 20	- 110	- 177
200-299	-1264	- 306	+ 6	-1564
300-399	+ 239	- 1	+ 5	+ 243
400-499	+ 102	+ 505	+ 5	+ 612
500-599	+ 251	+ 98	-	+ 349
600-699	+ 409	+ 19	*	+ 428
700 +	+ 336	*	*	+ 336
	- 147	+ 295	- 198	- 50

* No ships in these classifications

TABLE D3

Montreal-Lake Ontario Section

1964 Ship Transit and Commodity Cargo Traffic

by Size and Type of Ship Service*

	Ships #	Transits #	Bulk Cargo (000 tons)	General Cargo (000 tons)	Total Cargo (000 tons)
Ships Under 400'					
Laker service	96	1902	3993	374	4367
Ocean service	139	831	578	1012	1590
Other	108	496	32	33	65
	343	3229	4603	1419	6022
Ships over 400'					
Laker service	n/a	1878	24482	32	24514
Ocean service	n/a	1661	6541	2226	8767
Other		11	6	-	6
		3550	31029	2258	33,287
Total	1000**	6779	35,632	3,677	39,309

* There are some ocean type ships in essentially laker service and there are a few small ships classed as lakers and the new large ocean/lakers which take part in ocean service.

**Guesstimated on basis of pre clearance applications.

TABLE D4

MONTREAL - LAKE ONTARIO SEAWAY TRAFFIC 1964 IN SHIPS UNDER 400 FEET IN LENGTH BY SERVICE CLASSIFICATION WITH TRAFFIC CAPTIVE TO SMALL SHIPS INDICATED IN BRACKETS*

	Ships #	Transits #	Bulk Cargo (000 tons)	General Cargo (000 tons)	Total Cargo (000 tons)
Coastal Service					
Great Lakes - Atlantic Ports	12 (6)	134 (70)	282 (130)	166 (70)	448 (200)
Ships that used the Lachine Canal	13				
Lachine Canal	(6)	200 (200)	509 (509)	- -	509 (509)
Other	(2)	284 (120)	627 (270)	42 (42)	669 (390)
Tankers with petroleum products	33 (25)	713 (550)	1460 (1100)	-	1460 (1100)
Domestic packaged freight	4 (0)	65 (0)	106 (0)	4 (0)	110 (0)
Quebec Pulpwood - Tonawanda	3 (0)	52 (0)	16 (0)	-	16 (0)
Other Laker Service	31 (10)	454 (150)	993 (320)	162 (60)	1155 (380)
Overseas Service					
Great Lakes Ports - Overseas	139 (70)	831 (450)	579 (300)	1012 (500)	1591 (800)
Other Non-Cargo Vessels	108 (100)	496 (300)	32 (32)	33 (33)	65 (65)
TOTAL	343 (219)	3229 (1840)	4604 (2661)	1419 (705)	6023 (3444)

* Captive traffic is the traffic service which can only be performed by small ships because of the small volumes handled and/or because the harbours used cannot accommodate larger ships. If the volume of traffic increases and harbours are improved, the less traffic would be captive to the smaller ships. Some of the traffic indicated as captive to small ships could be handled by the railways.

A STUDY OF POTENTIAL IRON ORE TRAFFIC VOLUME THROUGH THE ST. LAWRENCE SEAWAY TO 1980

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SUMMARY

The two largest iron ore mining regions in North America are located at opposite extremities of the Great Lakes system and use this natural transportation link to reach markets in areas near the southern shores of Lake Michigan and Lake Erie. Mining ventures located at the eastern extremity of this water system also have easy access to large iron making capacity in Eastern Pennsylvania and Maryland through U.S. Atlantic ports.

Iron ore production is largely owned or controlled by nine of the largest steel producers in the United States and four iron ore houses, themselves closely tied to the steelmakers (See page 28). Generally speaking, the companies who own the three major iron ore producing ventures situated in Quebec/Labrador also control substantial capacity in Minnesota, Michigan and Wisconsin. Consequently future ownership patterns and policies will have a considerable effect on regional development and on the ability of various ores to retain traditional markets.

Study of the present origin destination pattern indicates that substantial quantities of Canadian and foreign iron ore are moving through the St. Lawrence Seaway as far west as Chicago (See page 46). Furthermore, it appears that the present cost structure allows Seaway ore to penetrate as far east as the Pittsburgh district (excluding Monessen and Johnstown) against competition of similar Canadian and other foreign ores shipped through U.S. Atlantic ports.

N.B. Net tons of 2000 lbs. used throughout this report unless otherwise noted.

It is expected that the St. Lawrence Seaway including the Welland Canal will carry the following quantities of iron ore in 1972 and 1980 respectively (millions of tons).

St. Lawrence Section	Welland Section	St. Lawrence & Welland Sections	
1964	1964	1972	1980
12.2	16.8	21.0	26.0

Downbound movements on the St. Lawrence section are expected to be negligeable and on the Welland section are not expected to exceed two million tons after 1969/70. Under certain conditions traffic through the St. Lawrence section could exceed traffic on the Welland section during the period 1970 - 1980.

The estimates given above are made on the basis of the following background analysis:-

- Consumption of iron ore by the North American steel industry should reach approximately 163 million tons in 1972 and about 194 million tons in 1980.
- Great Lakes ports will absorb approximately 55% of total consumption or roughly 90 million tons of iron ore in 1972 and about 107 million tons by 1980.
- These requirements of iron ore at Great Lakes ports will likely be met as follows:-

Origin of ore	Percent of total requirements. 1964 (actual)	1972	1980
U.S. Great Lakes	79.3%	67 - 70%	65 - 68%
Canadian Great Lakes	6.0%	7 - 8%	9 - 10%
Seaway ore	14.7%	23 - 25%	23 - 25%

- The projections made are further supported on the basis of known development plans in the three regions listed above.

All Seaway traffic estimates could be modified by a number of possible future developments which may tend to affect the competitiveness of the Seaway link. These potential developments include changes in water and rail freight rates, trends in the comparative costs of producing ore in Eastern Canada and in the U.S. Lake Superior region, the selective introduction of year round transportation on the Great Lakes, the effect of increased vessel size on the lakes as a result of the new lock currently under construction at Sault Ste. Marie, use of integral trains on land and barge trains on the water, pipeline carriage of iron ore, and finally the influence of cheap overseas ore supplies.

Summary Table

ESTIMATED PASSAGE OF IRON ORE THROUGH WELLAND AND ST. LAWRENCE CANALS 1965 - 1980
(In millions of tons)

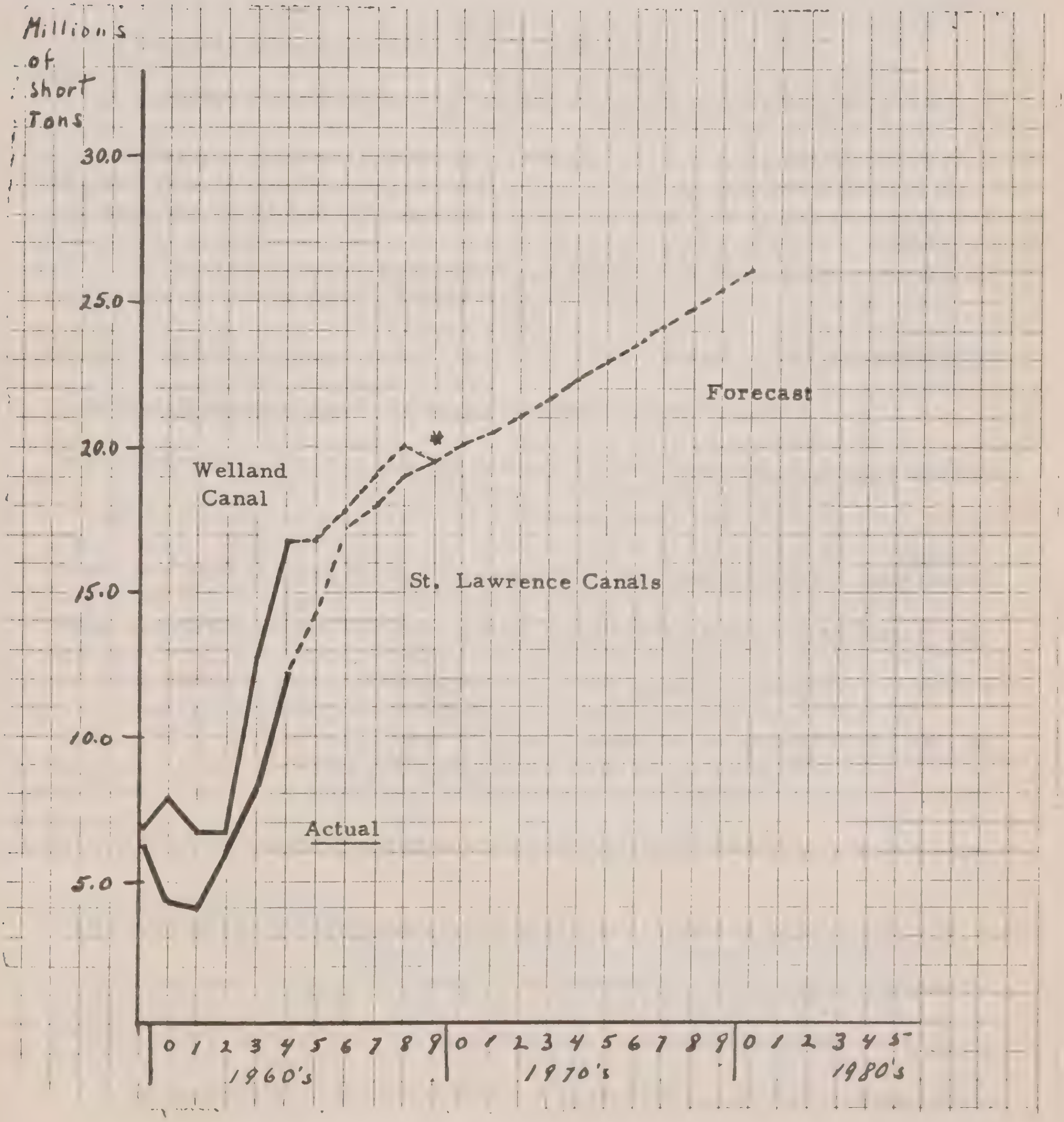
Year	St. Lawrence Canals*	Welland Canal	Remarks
1965	14.2	16.8	Wabush 2 M. Hamilton to take 1M tons.
1966	17.2	17.8	Wabush 4.5M. Hamilton to take 2M tons.
1967	18.0	19.0	Picton shipping at rate of 0.8M tons.
1968	19.0	20.0	Imports transferred at Contrecoeur. 1M tons.
1969	19.5	19.5	Strathagami mine shipping. 1M tons to DOFASCO.
1970	20.0	20.0	I.O.C.C./Quebec Cartier Agglomerate plants ?
1971	20.5	20.5	New Labrador Mining pellet project
1972	21.0	21.0	possible at this time.
1973	21.6	21.6	
1974	22.3	22.3	
1975	22.9	22.9	General expansion of Quebec/Labrador
1976	23.5	23.5	pellet capacity based on existing plants.
1977	24.1	24.1	
1978	24.7	24.7	
1979	25.4	25.4	
1980	26.0	26.0	

N.B. Figures for the years 1965 - 1972 based principally on known expansion plans and expected trends. Estimates for the years 1972 - 1980 based mainly on expected trends only.

* Assumed equal to Welland tonnage 1969 - 1980 but could be greater

SUMMARY GRAPH

Estimated Passage of Iron Ore Through Welland and St. Lawrence Canals
1965 - 1980



*It is assumed that by 1969 the St. Lawrence River section will carry the same amount of ore as the Welland Canal.

PREFACE

TERMS OF REFERENCE

The present study forms part of a larger work designed to provide the St. Lawrence Seaway Authority of Canada with an estimate of total traffic volume expected to pass through the Seaway in future years. The years chosen as the basis for the report are 1972 and 1980, although an attempt is also made to quantify the intervening years as well.

METHODOLOGY

A major determinant of the volume of ore moving through the Seaway system is the total level of demand for this product generated by the North American iron and steel industry. The first chapter discusses the trends that are taking place within the industry at the present time and surveys a number of recent estimates of future steel and ore requirements with a view to establishing a figure which, in our opinion, is an adequate guide to the ore requirements of the industry in 1972 and 1980. In other words, this chapter seeks to establish an overall order of magnitude to serve as the framework for an analysis of the role of the Seaway in the transportation of iron ore.

The second chapter lays the groundwork for further analysis by describing the mining operations in the Quebec Labrador area and investigating the historical pattern of shipments of iron ore through the Seaway for the years 1960 - 1964. We proceed to establish the general area of the

Continent receiving its supplies of iron ore through the Seaway Route.

Chapter Three attempts to forecast the quantity of iron ore required by these iron and steel producing centres through Great Lakes ports and the volume that the region will likely receive by way of the Seaway route. Chapter Four is really a supplement to the analysis of Chapter Three in that it seeks to review a number of possible developments which could potentially complicate future prospects for the Seaway as a competitive route in the transport of iron ore, e.g. Seaway v. East Coast freight rates, comparative costs of production, winter navigation on the Great Lakes, etc.

A number of assumptions have been made during the course of this work. The most important of these is that there will be no change in the Seaway toll structure for the period under review. We have also assumed that there will be no major wars or economic depressions and that there will be no dramatic technological breakthroughs which will enable competitive materials, e.g. plastics, fibre glass or aluminum to make unforseen inroads into the market for steel.

ACKNOWLEDGEMENTS

We wish to acknowledge the splendid assistance of all those in business and government who gave part of their knowledge toward the production of this report. Special thanks are directed to staff members

Mr. R.B. Elver, both of the Department of Mines and Technical Surveys,

(Ottawa) whose ready co-operation and advice is most appreciated.

N.B. We would caution those accustomed to rate iron ore production, capacity, etc. in terms of gross tons, that quantities are expressed in net (short) tons of 2,000 lbs. throughout this report unless otherwise specified. This is in conformity with general practice followed by shipping statistics.

CHAPTER ONE

IRON ORE IN NORTH AMERICA 1972 & 1980

This chapter is designed to provide the framework for a study of potential Seaway transport of iron ore, by investigating the over-all ore requirements of the United States and Canadian Iron and Steel industries in 1972 and 1980. It is not our purpose to add still another forecast to the excellent work that already exists in this field. We have instead reviewed a number of studies completed within the last ten years or so, and drawn conclusions from a critical evaluation of two recent investigations of future steel and ore requirements.

First of all however, we will briefly describe the nature of iron ore and its technical and economic relationship to iron and steel.

WHAT IS IRON ORE ?

Iron ore dug out of the ground is not pure iron, but may vary in iron content by anything from about 20% Fe to about 68% Fe. In fact, there is considerable argument as to just what should be considered as iron ore, since iron is the fourth most abundant element found on the earth, probably constituting about 4% of the earth's crust. The answer to the dilemma is found in economic and technical considerations rather than the iron content present in the ore body. For this reason the definition of what constitutes iron ore varies both with time and from place to place. To all intents and

purposes, 70% Hematite (Fe_2O_3) or 72% Fe Magnetite (Fe_3O_4) ore is pure iron ore. Limonite or Brown ore may be composed of a group of natural hydrous iron oxides which when pure may have an iron content ranging from about 52% to 66%.

Iron ores are also described as to whether they are direct shipping ores, concentrated ores or by-product and co-produced ores. Direct shipping ores may be used in the blast furnace as mined, with no treatment other than crushing and sizing being needed. Concentrated ores require some form of beneficiation before they can be used as blast furnace feed. By-product and co-product ores are derived from the mining and treatment of an ore from which some other valuable constituent is also recovered.

The physical condition of an ore is also an important market factor and can have a material effect on its price. Deposits are classified as hard ores, when containing dense, massive ores which break into lumps, or soft ores which, when mined and crushed, result in granular and earthy products. Lump ores of suitable chemical analysis are used for open hearth feed and command a premium. An excessive amount of fine ore in the burden can choke up the blast furnace, interfere with the free movement of gases, and clog the dust catchers.

An ideal ore physically would be one of uniform sizing so as to give ample interspaces, and in small enough pieces to present good surface areas for the attack of the reducing gases. Even better furnace results are obtained if the charged ore is porous.

Chemical analysis of iron ores is one of the major factors used to establish its price. The ore is classified according to the presence of various impurities as follows:-

Grade Classifications	Impurity Content
Bessemer	Phosphorous - not over .045%
Low Phosphorous non-Bessemer	Phosphorous - .045 - .180%
High Phosphorous non-Bessemer	Phosphorous - over .180%
Magniferous	Manganese - 20% or over
Siliceous	Silica - 18% or over.

A record of Lake Erie base prices is given in Table No. 1.

There has recently been a strong tendency for an increase in the demand for higher grade ores in North America. Until the mid-fifties, the iron ore charge in North American blast furnaces had varied little from the Lake Erie price standard of 51.5% Fe but from the year 1954, this began to change rapidly and by 1963 the average grade consumed in the United States had risen to almost 58%. It is considered by many that in future, ore containing under 60% Fe will face competition previously unknown in the history of the industry. This is due to the extraordinary

savings in cost and increased production of blast furnaces made possible by high grade ores. In 1960, H.S. Harrison [1] made the point that when 62% iron ore replaces ore with 52%, "the production of a blast furnace will be increased by 20% from the increased iron analysis alone. Thus if a company has five furnaces, in effect, they have built a sixth if they use high grade iron ore, and their labour costs would be correspondingly reduced because the same crew would be used to get the additional tonnage". This will undoubtedly have a considerable effect on the quantity of ore transported in the future.

What in the past was generally direct shipping (i.e. unconcentrated) ore grading 51 - 52% Fe will in future be 60 - 65% Fe concentrates and pellets, i.e. a reduction in the total volume of ore per unit of iron.

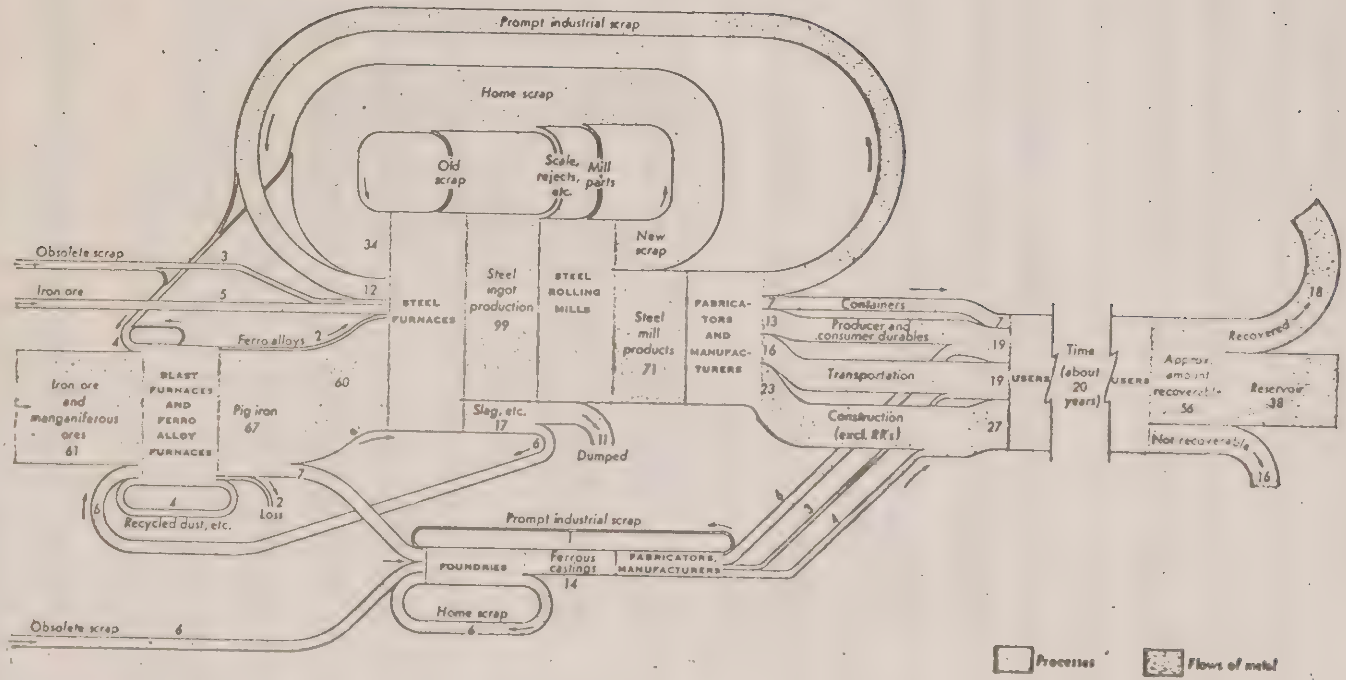
ORE, IRON AND STEEL

It is clear that the major factor to be considered in a study of the transportation of ore is just how much iron ore will be needed to produce a certain quantity of iron and steel[2]. What may be less obvious is that the relationship between ore and metal production is not a simple one since production of iron and steel is dependant on consumption of individual ferrous metallics in varying proportions, depending on the current state of iron and steel technology and the comparative costs of these input materials.

(1) Eng. Min. J. July 1960.

(2) We have, throughout this study neglected the small quantities of iron ore which are used in the paint industry, for concrete, agriculture, etc.

APPROXIMATE FLOW OF FERROUS METALS THROUGH THE U.S. ECONOMY 1960.



Source: Resources in America's Future.

A look at Figure one may help one to understand the role played by iron ore in the production of iron and steel products. The figures are in millions of tons and represent the flow of ferrous metals through the United States economy during the year 1960. The following facts are revealed by this diagram:-

- Iron ore consumption depends mainly on the production of pig iron although small quantities are consumed in steel furnaces.

- Pig iron is consumed both by steel furnaces and in iron foundries.

- Large amounts of scrap are consumed in both steel furnaces and iron foundries which themselves produce large quantities of home scrap.

- Large additional quantities of prompt industrial scrap are made available during the fabrication of iron and steel products.

- Obsolete scrap is made available from the reservoir of iron and steel products produced during a previous time period.

The most useful function of the diagram for our purposes is that it clearly illustrates the importance of scrap as one of the major factors determining the demand for pig iron and hence for iron ore. What factors determine the proportions of pig iron and scrap consumed? The answer lies in the comparative economics of these two products, largely determined by the prevailing state of technology in the industry.

We have already seen how the use of high grade concentrate has influenced the efficiency of the blast furnace and the production of pig

iron. We shall now turn to the factors which may tend to affect the demand and supply of iron and steel scrap.

IRON AND STEEL SCRAP

Of the three major steel making furnace types in use in North America, the Open Hearth remains by far the most important in the production of steel. Open Hearth steel accounted for over 77% of total steel production in the U.S. in 1964 as against roughly 12% for Basic Oxygen and 10% for electric furnace steel. The Open Hearth furnace usually operates with a charge of about 60% pig iron and 40% scrap. The proponderance of Open Hearth facilities has tended to keep the pig iron/scrap ratio relatively stable. However, various improvements in open hearth steelmaking such as the use of desiliconized hot metal, the oxygen jet process etc. may play a part in stimulating demand and use of scrap rather than pig iron.

As will be noted from Table No. 2, there has been a strong growth in both Basic Oxygen and electric Steel making in the United States since 1960. The Basic Oxygen Furnace uses about 30% scrap only while the Electric Furnace generally consumes scrap almost exclusively. According to a United Nations Report * on steelmaking processes, "oxygen converters of different types and electric arc furnaces will be built almost exclusively in new steel shops", and it goes on to state "what is far less certain is which of the two essentially different processes, i.e. oxygen converters and electric furnaces - will be used and to what extent, and in what conditions one or the other will be preferred". The report in fact sees some

* "Comparison of Steel-Making Processes", Economic Commission for Europe 1962. Cat. No. 62.11.E.4.

advantages in a combination of cold charged electric furnaces working entirely on scrap and oxygen converters using a relatively limited quantity of scrap, in order to be able to vary the inputs of scrap metal as dictated by the relative price of this material.

Present trends in the United States however, would seem to give the edge to Basic Oxygen converters in this development away from Open Hearth Steelmaking although it is difficult to forecast to what extent this will effect the consumption of scrap.

The supply picture for scrap will also affect consumption by its influence on the price of this material. Most of the available information on scrap generation comes from a 1957 study by the Batelle Memorial Institute for the U.S. Department of Commerce, and a follow-up study made by the Department of Commerce itself.

There are three major sources of iron and steel scrap which are generally labelled as home scrap, prompt industrial scrap and obsolete scrap. These sources are well illustrated in Figure 1 but we can amplify by saying that "home" scrap is the scrap generated within the steel mills themselves, prompt industrial scrap is generated by operations within the plants of the fabricators of final steel products, and "obsolete" scrap represents discarded articles originating with railroads, auto-wreckers and other demolition of all kinds.

Each of these sources will be subject to the vicissitudes of economic and technological change. For example, the supply of home scrap and prompt industrial scrap will depend to a large extent on the pace of current production, improved rolling mill and foundry techniques and the exacting demands of consumers for better quality and a wider variety of shapes. A process that would greatly reduce the supply of home scrap is further development of continuous casting. This possibility will depend largely on advances in the technological field. Obsolete scrap supply will depend on the extent of the accumulated reservoir of iron and steel products due for retirement or demolition. To complicate the matter still further, much will depend on the export market for scrap which has been growing in recent years.

In summary, major factors which influence the consumption of scrap are as follows:-

<u>Increased Consumption</u>

- New Developments in Open Hearth Steelmaking.
- Growth of electric steelmaking.
- Increased supply (i.e. fall in price) due to:-
    - New quality demands for steel shapes
    - Availability of cheap import scrap
    - Increased utilisation of obsolete scrap.

<u>Decreased Consumption</u>

- Growth of Oxygen Steelmaking
- Decrease in supply (i.e. rise in price) due to:-
    - Improved mill and foundry techniques
    - Development of Continuous Casting

- Development of New export markets
- Decreased utilization of obsolete scrap.

IRON ORE REQUIREMENTS

One may get the impression that the complexity of the iron and steel industry makes it difficult to establish a meaningful forecast of future requirements of iron ore. There are so many variables, particularly in the present situation of rapid technological change in all phases of the industry. However, this was probably not as important in the past as it is now. We have already seen that the iron content of ore remained remarkably stable until the early 50's. The input of pig iron as a proportion of total input of ferrous metallics in the production of iron and steel has been running between 48 - 50% in the United States for some years. Furthermore, steel ingot production has always been considered the standard measure of the production of steel.

Much of this could change in the future. The iron content of ore may soon be in the 62 - 65% range. The proportion of pig iron in the total input mix could change and indeed seems to be rising over the past four or five years. It is difficult to judge whether this will continue. The reliance on the steel ingot figure may have to be abandoned shortly as continuous casting eliminates the ingot stage from the production cycle altogether. For these reasons, a good deal of work that has been done over the last ten years to forecast the demand for steel and iron ore must now be considered out of date.

A list of the studies reviewed for purposes of this report, together with their sources is given in Tables 4 and 5.

We have reached our conclusions regarding future consumption of iron ore on the basis of two recent studies which, in our opinion stand out by their method and attention to detail. One is a study by the United Nations on World Steel supplemented by further work done in Sweden* to translate the figures on Steel production in terms of iron ore requirements for the period 1972 - 1975. The other is a study by Resources for the Future Inc. which traces future demand for iron and steel products back to the resource base, making use of an extensive assemblage of past historical data. Unfortunately, this latter study does not include an assessment of the Canadian market. The basic conclusions of these two studies are as follows: Iron ore figures refer to the iron content of the ore.

United Nations (Period 1972 - 1975)
(Figures translated to short tons).

	Production Steel Ingots (tons)	Consumption of Iron in Ore (tons)
United States	162,500,000	86,200,000
Canada	13,200,000	7,000,000
Total North America	175,700,000	93,200,000

Resources for the Future (Period 1970)

	Production Steel Ingots (tons)	Consumption of Iron in Ore (tons)
United States	141,000,000	89,900,000

* A.S. Lundberg. Bladet for Handteringens Vanner. Vol. 34, No. 1, Jan. 1960.

These studies probably represent the most complete analyses that have been undertaken in the steel industry in recent years. A comparison of both estimates with previous work reveals that the latter were somewhat too optimistic, probably in view of the strong steel demand current in the United States during the years 1955 to 1957. Since the Resources for the Future study presents the complete picture from final product to resource base, we will discuss its findings in greater detail.

RESOURCES FOR THE FUTURE IRON AND STEEL STUDY

The study undertaken by Resources for the Future Inc. was published in 1963 in a book entitled "Resources in America's Future - Patterns of Requirements and Availabilities". (John Hopkins Press). This study used what may be termed the "end use" approach. In other words, it proceeds by forecasting the demand from each iron and steel consuming sector of the economy and working back to the quantities of steel ingots, pig iron and iron ore required to fill projected requirements. A summary of the major indicators used together with medium projections to the year 2000 is given in Table No. 6.

The figures for the consumption of iron ore for 1970 were estimated as follows:-

Low	-	128.1 million tons
Medium	-	169.6 million tons
High	-	215.6 million tons

In the light of the history of the last few years it would appear that the medium projection of 169.6 million tons may not be reached by 1970. This figure was

arrived at on the basis of two main assumptions:

- That the pig iron/scrap ratio would be 50:50, i.e. declining from 1960.

- That the iron content of ore would be 53%.

Experience since 1960 has shown that the pig iron/scrap ratio has remained fairly stable at about 54/46 with perhaps a slight tendency to rise (See Table 7). Should basic oxygen steel further increase its percentage of the steel market in the United States, this could raise this ratio by 1972 - 1980 thereby increasing the demand for iron ore. However, the possible influence of new economic and technological developments make it necessary to be extremely cautious about this.

On the other hand, greater importance must be given to the recent increase in the iron content of ore from roughly 53% in 1955 to about 58% in 1963. A recent study by the Minnesota Natural Resources Council estimated that the iron content of acceptable ores will rise to an average approaching 62% in the next few years. E. H. Rose suggested in 1961 that future ores will grade over 60% Fe and perhaps up to 65% Fe*. If we accept the figure of 62% Fe and apply it to projected requirements of iron in ore for the year 1970 (89.9 million tons) we arrive at a total of 145.0 million tons rather than 169.6 million tons. Adjusting for the year 1972, we have:-

* "Iron Ore: The Big Picture". Blast Furnace, Coke Oven and Raw Materials Conference, 1961.

See also R. W. Hyde, B.M. Lane and W. W. Glaser. "Iron Ore Resources of the World". Eng. Min. J. Vol. 163, No. 12. December 1962.

	Tons
Iron in ore	94.1 million
Iron ore (60% Fe)	156.8 million
Iron ore (62% Fe)	151.7 million
Iron ore (65% Fe)	144.8 million

We may conclude that the quantity of ore carried to U.S. Blast Furnaces and steel mills will run in the order of between 145 - 155 million tons in 1972. The actual figure will probably be in the neighbourhood of 152 million tons on the basis of present trends in the iron content of ore.

CANADA

There has unfortunately been no recent forecast of iron ore requirements in Canada equal in scope to the Resources for the Future study in the United States. The Gordon Commission report on Canada's Economic Prospects estimated 15 million gross tons of domestic consumption of iron ore by 1980. This was based on a steel forecast of 12 - 14 million tons but it did not specify what iron content this might represent. Mr. R. L. Cavanagh, a director of the Ontario Research Foundation estimated in 1958 that Canada would consume 12 million gross tons of ore by 1980 based on an iron content of 50%. Most attention has been given to estimating the total future ore shipments from Canadian Mines, not on consumption of ore by the Canadian Steel Industry.

We have used the estimate of 7 million tons arrived at from the work presented by Mr. Lundberg. This figure cannot claim the same degree of analytical support as the figures available in the case of the United States. In fact the estimate is perhaps somewhat on the low side. However,

in view of the weight of Canada in the North American iron and steel picture (under 10%) we do not believe that the final result will be impaired by using it to calculate total North American requirements of iron ore. In 1972, these should be as follows (in millions of tons).

	United States	Canada	Total
Iron in Ore	94.1	7.0	101.1
Iron Ore (60% Fe)	156.8	11.7	168.5
Iron Ore (62% Fe)	151.7	11.3	163.0
Iron Ore (65% Fe)	144.8	10.8	155.6

The Resources for the Future study is used in the same way to arrive at a further projection for the year 1980. Canadian requirements are estimated to reach 9.3 million tons iron content for that year and total requirements are therefore of the following order (millions of tons).

	United States	Canada	Total
Iron in Ore	110.9	9.3	120.2
Iron Ore (60% Fe)	184.8	15.5	200.3
Iron Ore (62% Fe)	178.9	15.0	193.9
Iron Ore (65% Fe)	170.6	14.3	184.9

These figures would clearly be too high should there be any serious development of direct reduction or pre-reduction techniques during the next decade. We have chosen not to take such possibilities into account since it is difficult to foresee when the effects of their extensive application may start to be felt. We should perhaps mention however, that most authorities are of the opinion that the next development will be in the production of pre-reduced pellets grading perhaps 80% Fe of which about 35% would be

in metallic form. The 26th annual mining symposium at Duluth in January 1965 heard a report of the work which is currently proceeding at Michigan Technological University where direct shipping hematite ore containing 63.7% iron is ground and blended with anthracite coal and partially reduced in an indirectly heated laboratory furnace.

There are a number of direct reduction techniques such as the H-Iron, HYL, R-N, Strategic-Udy, etc. processes, some of which are operating commercially on a small scale. However, a large number of technical and economic problems remain to be solved and the present large investments in blast furnace facilities would seem to preclude any hasty rejection of the traditional method of producing pig iron.

CHAPTER TWO

THE DEVELOPMENT OF IRON ORE TRAFFIC 1954 - 1964

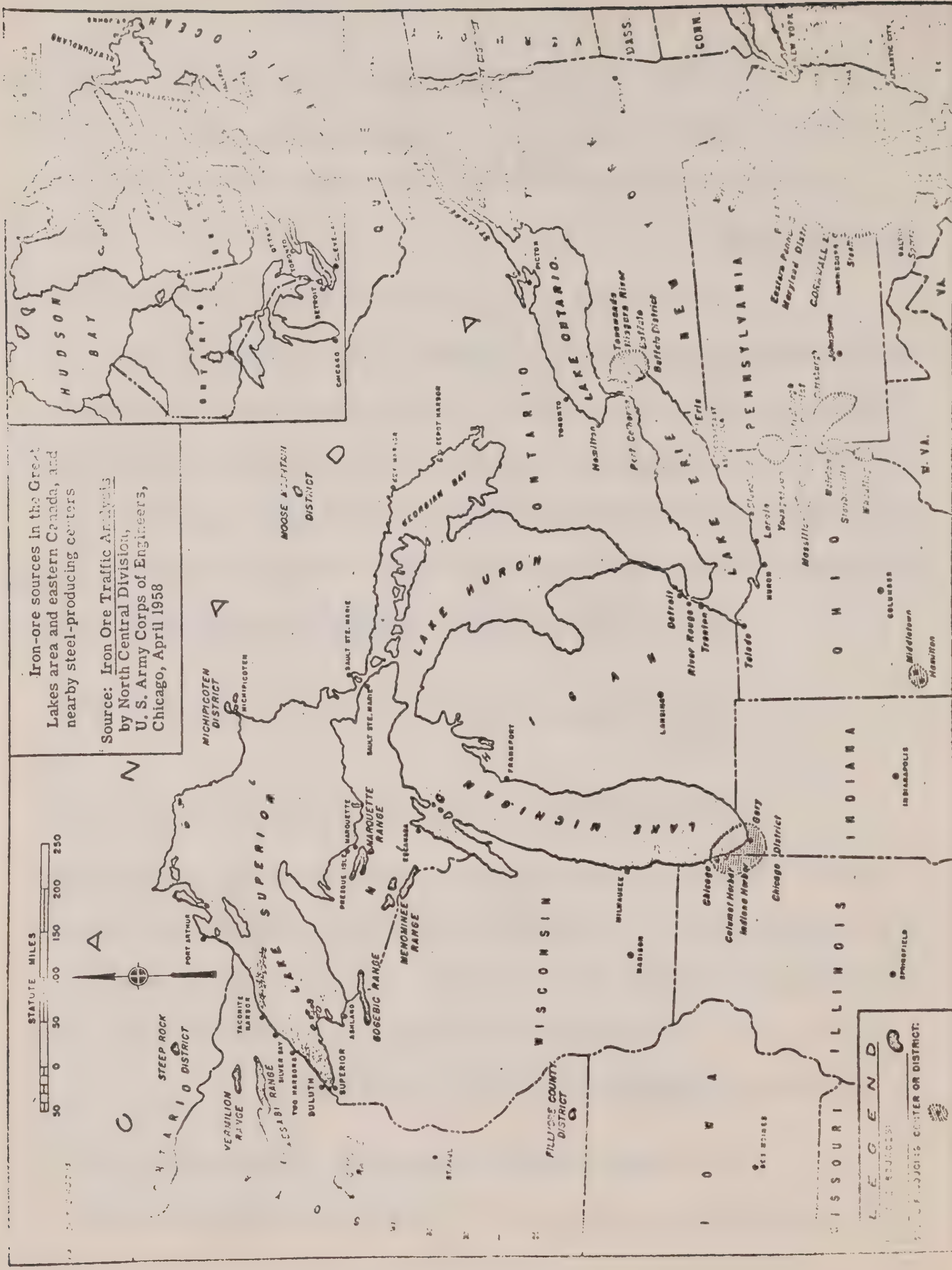
INTRODUCTION

The movement of iron ore through the St. Lawrence Seaway must be viewed as part of the total pattern of iron ore traffic in North America. Since the iron ore mining regions of the Continent are located principally in the Lake Superior and Quebec/Labrador areas, (See map page 26), shipment of ore to the steel producing centres along the Southern Great Lakes and in Eastern Pennsylvania/Maryland is primarily three way:

- Mesabi, Cuyuna, etc. ores easterly through the Great Lakes to the Chicago, Lake Erie and Hamilton areas.
- Quebec/Labrador ores westerly through the St. Lawrence Seaway to Hamilton, Lake Erie ports and as far West as Chicago.
- Quebec/Labrador ores easterly via the Gulf of St. Lawrence to the Eastern Pennsylvania/Maryland region and overseas.

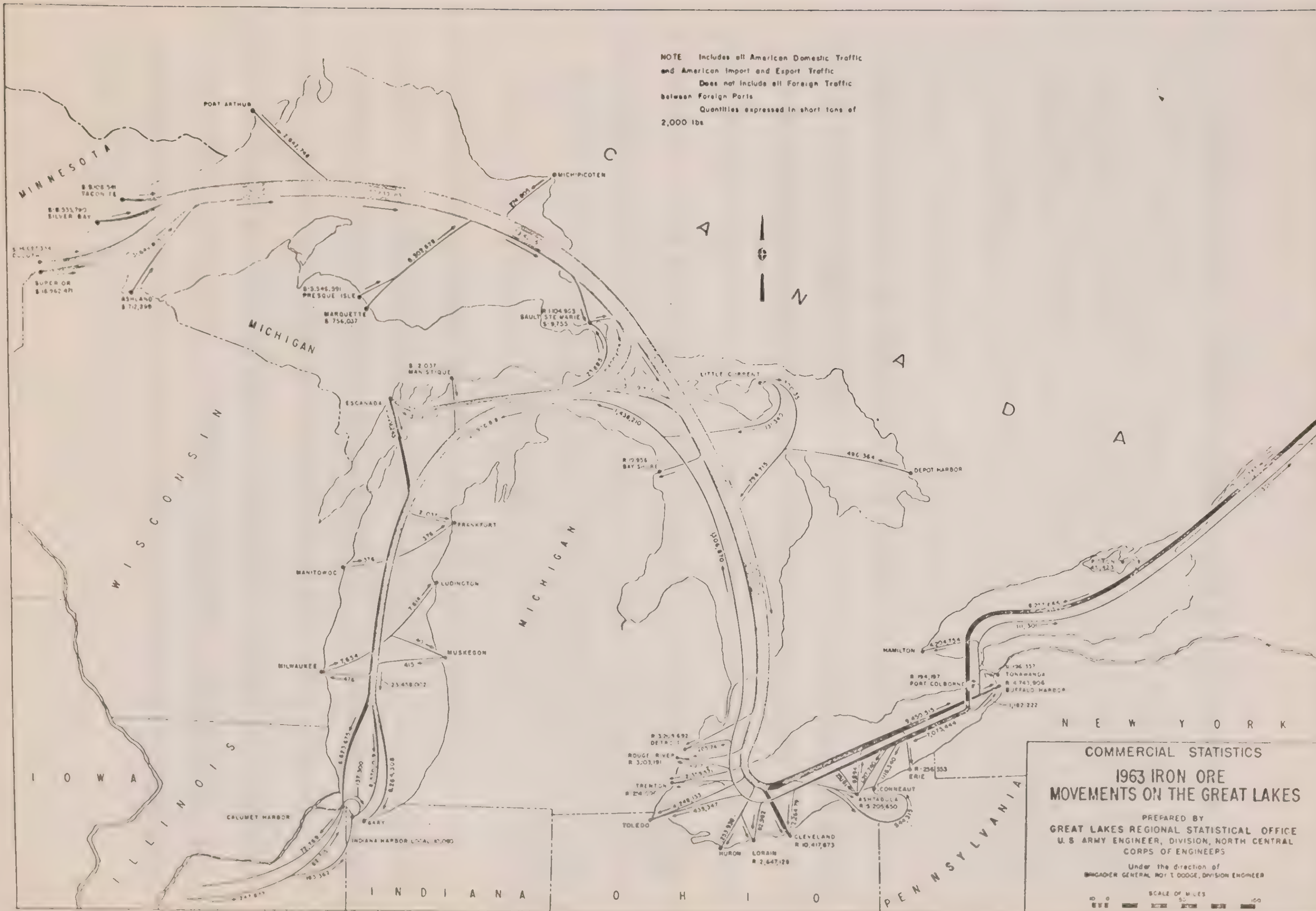
In addition to these major patterns we must also note the passage of foreign ores discharged at U.S. Atlantic Ports and of ores originating in the Adirondack mining area of Upper New York State. About half a million tons of foreign iron ore is also transferred to lakers at Contrecoeur for furtherance via the Seaway to mills situated near the Great Lakes.

The carriage of ore is therefore overwhelmingly by water, the St. Lawrence Seaway providing the necessary link between the Water



Iron-ore sources in the Great Lakes area and eastern Canada, and nearby steel-producing centers

Source: Iron Ore Traffic Analysis by North Central Division, U. S. Army Corps of Engineers, Chicago, April 1958


NOTE Includes all American Domestic Traffic and American Import and Export Traffic
Does not include all Foreign Traffic between Foreign Ports
Quantities expressed in short tons of 2,000 lbs
COMMERCIAL STATISTICS
1963 IRON ORE
MOVEMENTS ON THE GREAT LAKES
PREPARED BY
GREAT LAKES REGIONAL STATISTICAL OFFICE
U. S. ARMY ENGINEER, DIVISION, NORTH CENTRAL
CORPS OF ENGINEERS
Under the direction of
SCALE OF MILES
C A N A D A
MINNESOTA
WISCONSIN
MICHIGAN
IOWA
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
NEW YORK
PORT ARTHUR
MICHIPICOTEN
SILVER BAY
ASHLAND
PRESQUE ISLE
MARQUETTE
SAULT STE MARIE
ESCANADA
LITTLE CURRENT
DEPOT HARBOR
BAY SHORE
FRANKFORT
MANITOWOC
LUDINGTON
MUSKEGON
MILWAUKEE
CALUMET HARBOR
GARY
ROUGE RIVER
TRENTON
TOLEDO
HURON
LORAIN
CLEVELAND
ERIE
CONNEAUT
ASHTABULA
HAMILTON
PORT COLBORNE
TONAWANDA
BUFFALO HARBOR

Lanes of the Great Lakes and the Atlantic Ocean. The map given on page 27 is one of a series published annually by the U.S. Corps of Army Engineers and well illustrates the relative size of the ore movements on the Great Lakes. In fact, receipts of iron ore at Great Lakes Ports traditionally represent about 60% of the total volume of ore consumed in North America.

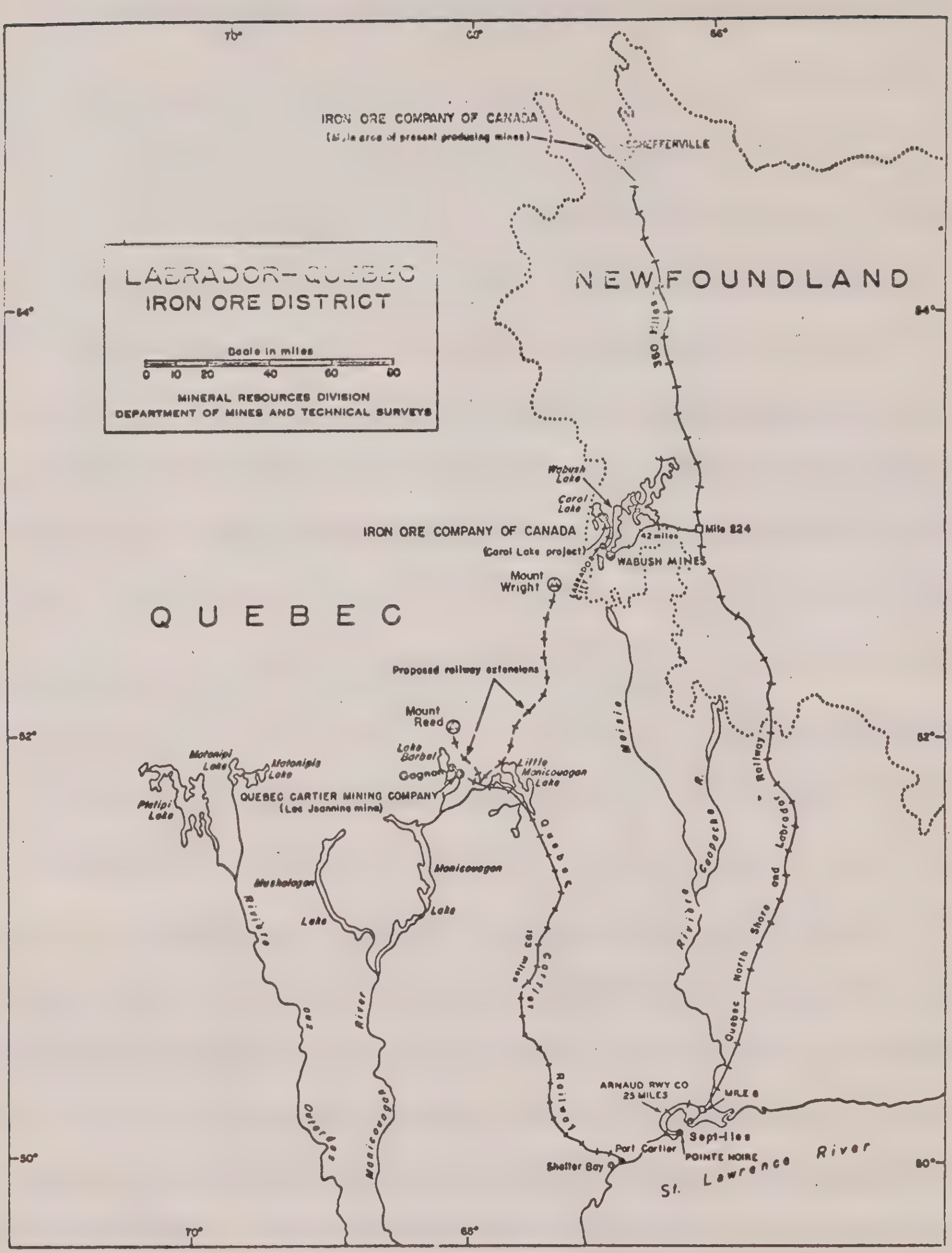
By far the greater part of the North American iron ore producing industry is owned or controlled by the nine largest steel producers in the United States supplemented by the two Canadian producers located in Hamilton. The balance is largely controlled by four iron ore houses, which, although they produce ore for sale only, are closely tied to the steel makers. Iron ore is therefore largely a "captive" product and ownership patterns and policies exert considerable influence on development and on the ability of various ores to retain traditional markets.

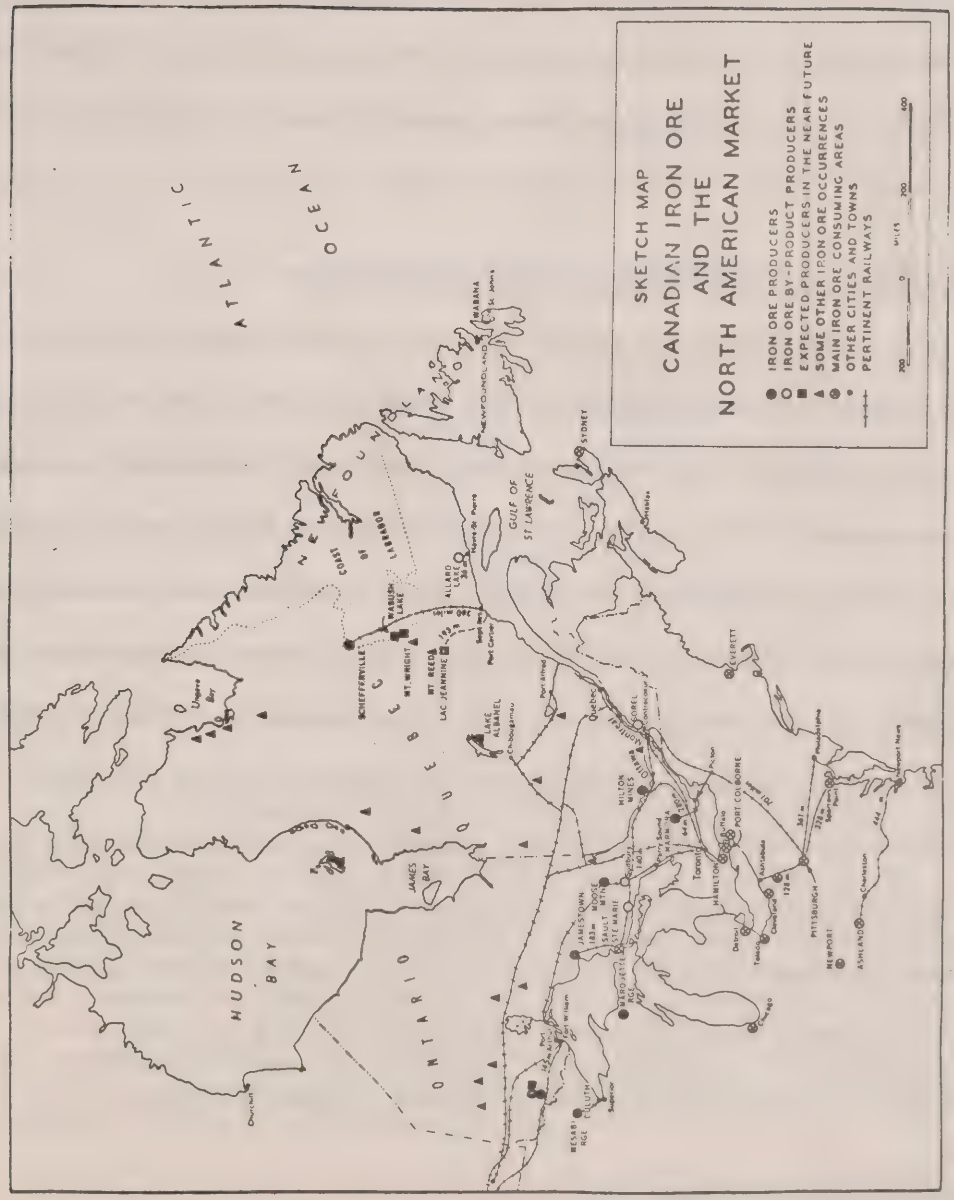
Eight of the nine steel companies (exception is Jones & Laughlin Steel Corp) and two of the iron ore houses concerned participate in mining facilities located at both extremities of the St. Lawrence Seaway system. Mines to the west are principally located in the states of Minnesota, Michigan and Wisconsin, and to the East in the Canadian provinces of Quebec and Newfoundland (Labrador). We might also mention in passing that much of the production in those overseas countries supplying iron ore to the United States

is also controlled by a number of the largest of these companies.

The huge investments represented by these mining ventures will generally ensure their continued operation. Furthermore, it is normal practice to blend several types of ore at the blast furnace site before the ore is charged to the furnace. For these reasons, transportation and other costs are not the only factors which determine the final destination or the competitiveness of one ore over another. A case in point is the fact that Quebec Cartier Mining Company last year shipped nearly three million tons of ore to the Chicago area, located considerably closer to the head of the Lakes.

The historical pattern of shipments of iron ore through the St. Lawrence Seaway has been primarily upbound, ore originating in the Quebec Labrador area moving towards the steel producing centers situated on or near the Great Lakes. In 1964 this movement represented a trifle over 75% of the total movement of iron ore passing through the Welland Canal and 100% of the traffic through the St. Lawrence section. The downbound movement, principally of Minnesota ore to Hamilton represented somewhat under 25% of total Welland traffic in iron ore for that year. This situation will begin to change in 1965 since both DOFASCO and STELCO in Hamilton have large interests in the new Wabush development. DOFASCO is planning to buy 800,000 tons of pellets per annum from this source and STELCO about 1,250,000 tons per annum.


LABRADOR-QUEBEC
IRON ORE DISTRICT
Scale in miles
0 10 20 40 60 80
MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
IRON ORE COMPANY OF CANADA
SCHEFFERVILLE
NEWFOUNDLAND
360 Miles
Wabush Lake
Carol Lake
IRON ORE COMPANY OF CANADA
(Carol Lake project)
Mile 224
42 miles
WABUSH MINES
Mount Wright
QUEBEC
Proposed railway extensions
Mount Reed
Lake Barbel
Gagnon
Little Manicouagan Lake
QUEBEC CARTIER MINING COMPANY
(Lac Jeannine mine)
Matonipi Lake
Pletipi Lake
Mushalagan Lake
Manicouagan Lake
Manicouagan River
Moisie
Quebec North Shore and Labrador Railway
Quebec Cartier Railway
193 miles
ARNAUD RWY CO 25 MILES
MILE 6
Sept-Iles
Port Cartier
POINTE NOIRE
Shelter Bay
St. Lawrence River
70°
65°
64°
52°
50°


SKETCH MAP
CANADIAN IRON ORE
AND THE
NORTH AMERICAN MARKET
IRON ORE PRODUCERS
IRON ORE BY-PRODUCT PRODUCERS
EXPECTED PRODUCERS IN THE NEAR FUTURE
SOME OTHER IRON ORE OCCURRENCES
MAIN IRON ORE CONSUMING AREAS
OTHER CITIES AND TOWNS
PERTINENT RAILWAYS
ATLANTIC
OCEAN
HUDSON
BAY
JAMES BAY
ONTARIO
QUEBEC
NEWFOUNDLAND
COAST OF LABRADOR
GULF OF ST LAWRENCE
SYDNEY
WABANA
SCHEFFERVILLE
WABUSH LAKE
MT. WRIGHT
MT. REED
LAC JEANNINE
ALLARD LAKE
LAKE ALBANEL
Quebec
SOREL
MILTON MINES
MOOSE MTN
JAMESTOWN
SAULT STE MARIE
MARQUETTE RGE
MESABI RGE
DULUTH
Toronto
HAMILTON
PORT COLBORNE
PITTSBURGH
NEWPORT
ASHLAND
EVERETT

The importance of the Quebec Labrador area as a source of ore traffic merits a brief description of the iron mining industry located in this region and an analysis of alternate sources of ore for participants in the three major ventures located in the area.

THE QUEBEC-LABRADOR IRON MINING INDUSTRY

More than one billion dollars has been invested since 1950 in iron mining and handling facilities in Labrador and North Eastern Quebec. Three companies are currently operating mines near Shefferville, Labrador City, Gagnon and Wabush Lake. Although the district is less than 10 years old, the nature of production has changed from a dominance of medium grade, direct shipping ore to high grade concentrate and pellets produced from low grade ores. In 1964 the net capacity of these mines was more than 28 million tons with 6.2 million tons of pellets, 10.6 million tons of high grade concentrate and over 11.2 million tons of medium grade ore. All ores shipped from this district are handled through the ports of Port Cartier, Pointe Noire and Sept Iles on the North Shore of the St. Lawrence River and proceed to inland markets via the St. Lawrence Seaway, to the East Coast of the United States and to Western Europe. Details of these companies are as follows:-

The Iron Ore Company of Canada

This company is currently exploiting seven mines all of which are open pit operations. Six of these are located astride the Quebec/Labrador border near the town of Shefferville, P.Q. and supply direct shipping earthy

hematite ore grading roughly 55% iron. These deposits were expected to provide 10 - 12 million long tons per annum when construction and development was completed in 1954 and provision was made for an increase to 20 million long tpy * if circumstances should warrant it.

The seventh (Smallwood) mine is located near the town of Labrador City lying 173 rail miles to the south and is designed to supply 7.8 million tons of concentrate annually. The Carol Pellet Company, an associate of I.O.C.C. completed construction of facilities designed to pelletize 6.2 million tons of this concentrate in May 1963. The ore from both Shefferville and Labrador City is railed to the port of Sept Iles. Shipment is year round in the case of concentrates and pellets, but direct shipping ores are usually shipped between mid-April and mid-November.

The Iron Ore Company of Canada was incorporated in 1949 by Hanna Coal and OreCorp. and five American Steel Companies, in association with two Canadian exploration companies that held leases on the ore deposits. A sixth steel company, Bethlehem, acquired an interest in the company in 1958. The ownership of I.O.C.C. and the Carol Pellet Company as of 1965 is estimated as follows:-

	I.O.C.C.	Carol Pellet Co.
Hollinger Consolidated Gold Mines Ltd.	14.33%	nil
Labrador Mining and Exploration Co. Ltd.	6.67	nil
Hanna Mining Co.	19.38	19.38
The M.A. Hanna Co.	8.33	7.23

* i.e. tons per year.

	I.O.C.C.	Carol Pellet Co.
National Steel Corp.	15.38	19.00
Republic Steel Corp.	5.13	5.13
Armco Steel Corp.	5.13	5.13
Youngstown Sheet and Tube Corp.	5.13	5.13
Wheeling Steel Corp.	4.10	8.00
Bethlehem Steel Corp.	16.42	31.00
TOTAL	100.00	100.00

Labrador Mining and Exploration Co. Ltd. is owned in part by both Hollinger Consolidated Gold Mines Ltd. (52.15%) and The Hanna Mining Company (18.3%). The Hanna Mining Company is largely controlled by The M.A. Hanna Co. (46.6%) who also have a 21.7% interest in National Steel Corp.

The Hanna Group represented by the first five companies listed above is therefore strongly represented within the ownership of the Iron Ore Company of Canada. This group plus the remaining five steel companies all have interests in iron producing facilities in the Great Lakes region as follows:-

The Hanna Group

This group of companies currently controls or manages about twenty seven open pit and three underground mines in the states of Minnesota and Michigan and one open pit mine in Ontario. Details are as follows:

Company	Number of Mines Minn.	Mich.	Ont.	Type of Product
Butler Brothers	5 (OP)			Concentrate
Hanna Iron Ore	1 (OP)			Concentrate
Div. National Steel		2 (UG)		Direct shipping
Lowphos Ore Ltd. (National Steel)			1 (OP)	Conc. & pellets
Hanna Mining Co.	6 (OP)			Concentrate
	1 (OP)			Direct shipping
		1 (UG)		Direct shipping
		1 (OP)		Pellets
Hanna Ore Mining Co.	6 (OP)			Concentrate
	1 (OP)			Direct shipping
Moreton Ore Co.	3 (OP)			Concentrate
Philbin Mining Co.	1 (OP)			Concentrate
S. Agnew Mining Co.	1 (OP)			Concentrate
	1 (OP)			Direct shipping

N.B. OP = Open Pit
UG = Underground.

The Hanna Mining Company recently announced plans for the construction of two further pellet plants.

1) A $50 million, 2,000,000 gross ton plant 15 miles west of Hibbing Minn. This will be a joint undertaking with Inland Steel Co. and Wheeling Steel Corp. Initial production is expected by the end of 1966.

2) A 2,400,000 gross ton pellet plant near Keawatin, Minn. This will be a joint undertaking with National Steel who will own 85% of the venture.

These new developments will increase the company's pellet capacity to a total of 5,650,000 gross tons annually.

National Steel Corp. (Lowphos Ore) pellet capacity at Moose Mountain 35 miles north of Sudbury, Ont. is rated at 625,000 gross tons per annum. Shipments in 1963 totalled 490,481 gross tons including 315,260 gross tons of concentrate and 122,221 gross tons of pellets.

In addition, National Steel Corp. has an interest in the following mining facilities:-

- Mahoning Ore and Steel Co. a subsidiary of Pickands Mather and Co. who operate a mine and concentrator at Hibbing, Minn.
- Mesaba-Cliffs Mining Co. a subsidiary of The Cleveland Cliffs Iron Company who have a mine and concentrator at Marble, Minnesota.
- Susquehanna Ore Co. controlled (50%) by Republic Steel Corp. They supply direct shipping ore from a mine at Hibbing, Minnesota.
- Teal Lake Iron Mining Co. a wholly owned iron ore property in Michigan.

Republic Steel Corporation

Republic Steel together with Armco Steel Corp. jointly own the Reserve Mining Co. which has the largest (9,000,000 gross tons capacity) pellet plant in the United States at Silver Bay, Minn. This company also operates two mines in the Adirondack region of New York state, (Mineville and Lyon Mountain) which have a combined annual capacity of approx. 1,150,000 gross tons of concentrate. We have mentioned that Republic has a 50% interest in Susquehanna Ore Co. at Hibbing, Minn.

It should also be mentioned that the company owns iron ore producing facilities in Liberia (The Prospect Corp).

Armco Steel Corporation

- Owns 50% of Reserve Mining Co. (See above under Republic Steel Corp.)

- Has part ownership in several other companies which operate mines in the U.S. Lake Superior District and in Texas.

Youngstown Sheet & Tube Corporation

In addition to I.O.C.C., Youngstown also has an interest in Wabush Mines and is therefore the only company participating in two major iron ore producing facilities in the Quebec/Labrador area. Other mining interests in Minnesota and Michigan are as follows:-

- Erie Mining Co. Participation (35%) is shared with Bethlehem Steel, Interlake Iron and Stelco. The company operates a pellet plant at Hoyt Lakes, Minn. with an annual capacity of 8,000,000 gross tons.
- Crete Mining Co. (Majority interest)
- Vermillion Mining Co. (Majority interest)
- Cuyuna Ore Co.
- Hoyt Mining Co.
- Mahoning Ore and Steel Co.
- The Mauthe Mining Co.
- Ontario Iron Co.
- Palmer Mining Co.
- Volunteer Ore Co.

Wheeling Steel Corporation

Has a 10% interest in the Marquette Iron Mining Company, (Cleveland Cliffs) who operate a 800,000 gross tpy pellet plant at Eagle Mills, Mich. Total receipts of pellets from this source were 350,000 gross tons in 1963.

Bethlehem Steel Corporation

The following mines are owned outright or partially by Bethlehem:

- Erie Mining Co. (45%) - produces pellets (See under Youngstown Sheet & Tube).

- Marmoraton Mining Co. (100%) near Marmora, Ont. Pellet plant has an annual capacity of 450,000 gross tons. Shipments in 1963 were 387,234 gross tons, all destined for the Buffalo district.

- Bethlehem Cornwall Corp. (100%) operates pelletizing facilities at Cornwall, Pa. and Grace Pa. with a combined annual capacity of 2,200,000 gross tons.

- Meremec Mining Co. (50%) has just completed a $52,000,000 pellet plant at Sullivan, Mo. with a capacity of 2,000,000 gross tpy.

- Various interests are held in mines located at Hibbing, Minn.; Negaunee, Mich.; La Serena, Chile; San Felix, Venezuela; and Buchanan, Liberia. These mines all supply direct shipping ore.

Quebec Cartier Mining Company

The Quebec Cartier Mining Company is a wholly owned subsidiary of United States Steel Corporation. It has been operating a mine and concentrator at Gagnon, Quebec since December, 1960. This operation has a capacity of about 9 million tons of specular hematite concentrate (64.4% Fe) annually. The concentrate is taken by rail to Port Cartier, 193 miles Southeast which can accommodate bulk carriers of up to 100,000 ton capacity all year round. A pellet (or possibly sinter) plant of about 4 million tons capacity may possibly be built in the next year or two.

U.S. Steel Corp., reportedly controls the largest holdings of iron ore reserves in North America, which prior to January, 1964 were largely managed through the Oliver Iron Mining Division. However, a major reorganization of the company has resulted that all domestic steel producing, mining and lake shipping operations are now integrated into a single steel making and selling organization. The company owns a large number of mines in Minnesota many of which supply direct shipping ore.

However, six of these supply high grade concentrate while the Extaca mine at Virginia, Minn. produces both sinter and high grade nodules.

U.S. Steel Corp. recently announced that it will begin construction of a large taconite pellet plant at Mountain Iron, Minn. as soon as possible. The initial phase will be site preparation to enable the Pilotac Mine (already producing concentrates) to yield the 13,000,000 gross tons of crude taconite which the plant will require each year. Annual production capacity of the plant will be about 4,500,000 gross tons of pellets by 1967.

Wabush Mines Limited

This company has just commenced mining operations at a site near Wabush Lake in Labrador, about 37 miles west of the Quebec North Shore and Labrador Railway operated by I. O. C. C. A 43 mile spur line joins the mine site with mile 224 on the QNSL railway and another spur line leaves this same railway at mile 8 to carry the concentrate to pelletizing and harbour facilities at Pointe Noire, across the bay from Sept Iles, Quebec. Plans call for an ultimate capacity of over 11 million tons of concentrate per year, though initially this will total roughly 5.9 million tpy.

An associate company, Arnaud Pellets has just completed the construction of a 5.5 million ton pellet plant near Pointe Noire, P.Q. in the Gulf of the St. Lawrence. This plant can be expanded if required.

It has not been decided whether shipment will be made on a year round basis although it is reported that the Monessen plant of Pittsburgh Steel Corp. will receive supplies via the East Coast. All other participating steel companies are better served via the Seaway route which will carry an estimated 80% of production. Total concentrate and pellet shipments in 1965 are not expected to exceed 2 - $2\frac{1}{2}$ million tons.

Wabush Mines is owned by Wabush Iron Co. Ltd., two Canadian steel companies and subsidiaries of two West German steel companies. Wabush Iron Co. Ltd. in turn is owned by an American merchant ore company, four American steel companies and an Italian steel company. The estimated percentage participation of each in Wabush Mines and in the associated Arnaud Pellets is:-

	Arnaud	Wabush Mines
Wabush Iron Co. Ltd.		
Pickands Mather & Co.	12.4	14.5
Youngstown Sheet & Tube Co.	15.0	9.4
Inland Steel Co.	7.8	9.4
Interlake (Iron) Steel Corp.	9.4	9.4
Pittsburgh Steel Corp.	9.4	9.4
Finsider	4.7	4.7
Steel Co. of Canada Ltd.	25.0	23.5
Dominion Foundries & Steel Ltd.	16.3	15.0
Mannesmann Canadian Iron Ores Ltd.) Hoesch Iron Ores Ltd.)	nil	4.7
TOTAL	100.0	100.0

All the Canadian and American companies participating in this venture have or shortly will have alternative sources of supply of iron ore, concentrate or pellets. Details are as follows:-

Pickands Mather and Company

This company is the largest of the independent American iron ore houses. The company controls or manages a number of mines in the States of Minnesota, Michigan and Wisconsin as follows:

Company	Number of Mines Minn.	Mich.	Wis.	Type of Product
Balkan Mining Co.	1 (OP)			Concentrate
Bennett Mining Co.	1 (OP)			Concentrate
Cornell Mining Co.		1 (OP)		Direct shipping
Erie Mining Co.	1 (OP)			Concentrate, pellets
Lake Mining Co.	1 (OP)			Concentrate
Mahoning Ore & Steel	1 (OP)			Concentrate
Mauthe Mining Co.		1 (UG)		Concentrate
Odanah			1 (UG)	Direct shipping
Puritan Mining Co.		1 (UG)		Direct shipping
Western Mining Co.	1 (OP)			Concentrate
Youngstown Mines Corp.	1 (OP)			Direct shipping

N.B. OP = Open Pit
UG = Underground

Youngstown Sheet & Tube

See under Iron Ore Company of Canada, pages 46 & 47.

Inland Steel Company

This company presently controls or has interests in the following iron mining operations:-

- Direct Shipping ore from three company mines located at Crosby, Minn.; Crystal Falls, Mich.; and Iron River, Mich. respectively. These are all underground operations.

- Pacific Isle Mining Co. a wholly owned subsidiary controlling four open pit mines in Minnesota supplying direct shipping ore.

- Caland Ore Co. a wholly owned subsidiary located at Atikokan, Ont. This open pit operation currently supplies direct shipping ore.

- An interest (est. 35.5%) in Empire Iron Mining Co. (Cleveland Cliffs). This company operates a 1,400,000 gross ton pellet plant at Palmer, Mich.

Two new ventures are currently in the development stage:

- Caland Ore Co. is nearing completion of its 1,000,000 gross ton pellet plant due to commence production this year.

- We have already mentioned the joint undertaking with Hanna and Wheeling Steel Corp. to construct a 2,000,000 gross ton pellet plant in Itasca County, Minn.

Interlake Iron Corporation

We have already mentioned that this company owns 10% of Erie Mining Co. Requirements of iron ore could increase as a result of the recent merger with Acme Steel Co. of Chicago.

Pittsburgh Steel Corporation

This company has interests in the following companies in the Lake Superior Mining area:

- Balkan Mining Co. (Pickands Mather), Bovey, Minn.
- Bennett Mining Co. (Pickands Mather), Keewatin, Minn.
- Corsica Iron Co. (Pickands Mather), Biwabik, Minn.
- Lake Mining Co. (Pickands Mather), Biwabik, Minn.
- Mesaba-Cliffs Mining Co. (Cleveland Cliffs), Minn.

These companies all produce concentrate of one kind or another.

Steel Company of Canada

This company has a 10% interest in Erie Mining Co. and will continue to receive pellets from this source. Interests are also held in a number of companies who supply iron ore concentrate as follows:-

- Banner Mining Co., Mich.
- The Mauthe Mining Co., Mich.
- Balkan Mining Co., Minn.
- Corsica Iron Co., Minn.
- Lake Mining Co., Minn.
- Ontario Iron Co., Minn.
- Western Mining Co., Minn.

Dominion Foundries & Steel Limited

This company recently announced its participation, with Cliffs of Canada Ltd. in a joint venture to be known as the Sherman Mine, located near Timagami, Ont. The estimated cost of Dofasco's 90% interest is approximately $40,000,000. Annual production of 1,000,000 long tons of pellets is expected within three years.

SEAWAY TRAFFIC IN IRON ORE

The year 1954 saw the first shipment of ore from the new Shefferville development in Quebec make its way up the St. Lawrence Canal System to the steel mills situated on or near the Great Lakes. Some iron ore was moved prior to that year but this consisted mainly of imported ores from Europe and elsewhere.

The development of this iron ore traffic has been as follows:

	St. Lawrence Canals		Welland Canal	
	Upbound	Downbound	Upbound	Downbound
1954	297,396	-	179,684	2,119,169
1955	1,750,567	-	1,587,423	2,810,484
1956	2,616,041	-	2,529,826	2,768,893
1957	2,489,648	7,397	2,594,758	2,888,988
1958	1,526,109	-	1,859,499	2,431,985
1959	6,272,757	-	5,384,356	1,912,117
1960	[illegible],315,432	-	4,242,105	3,614,374

	Upbound	Downbound	Upbound	Downbound
1961	3,803,294	238,422	3,640,085	3,056,676
1962	5,938,328	76,007	6,320,336	4,064,437
1963	8,048,749	102,719	8,353,664	4,355,161
1964	12,154,599	-	12,741,765	4,103,989

As can be expected, the most rapid growth has taken place in the volume of upbound traffic as a consequence of development of the Quebec-Labrador mining area. Quebec Cartier Mining Company started shipping concentrate at Port Cartier in 1961 but it was not until 1962 that volume shipments began to move up the Seaway from that port - hence the marked improvement in the upbound figures for that year.

The Iron Ore Company of Canada and Quebec Cartier Mining Company both ship ore to U.S. Atlantic Ports as well as through the Seaway. In the case of the I.O.C.C., some ore is also shipped to Europe. The pattern from Quebec/Labrador since 1954 has been as follows:-

	Total	Great Lakes via Seaway	Eastern Seaboard	Europe	Percentage via Seaway
1954	1,995,227	190,425	1,744,180	60,622	9.5
1955	8,648,640	1,696,073	6,155,127	797,440	19.6
1956	13,454,194	2,553,274	8,816,447	2,084,473	19.0
1957	13,927,938	2,476,740	8,211,418	3,239,780	17.8
1958	8,923,273	1,533,461	5,217,984	2,171,828	17.2
1959	14,609,759	5,876,316	5,716,739	3,016,704	40.2
1960	10,866,941	3,345,263*	3,999,654	3,522,024	30.8
1961	10,074,315	3,063,855*	4,063,400	2,947,060	30.4
1962	18,147,791	5,303,096*	10,034,124	2,810,571	29.2
1963	20,473,385	7,595,195*	9,243,070	3,635,120	37.1
1964	26,033,897	11,714,687*	10,696,953	3,622,257	45.0

* Data supplied by St. Lawrence Seaway Authority. (Remainder from Department of Mines and Technical Surveys reports converted to net tons).

The table shows clearly the effect of the opening of the St. Lawrence Seaway in 1959 on the pattern of ore shipments. These declined in 1960, but there has been a marked rising tendency since then.

Prior to the opening of the Seaway in 1959, most ore was trans-shipped at Contrecoeur on to so-called "canalers" capable of navigating the old shallow draft canals. Since that time, however, the ore has been moved in "lakers", vessels with a draft of up to $25\frac{1}{2}$ ft. and capable of transporting up to 25,000 tons of ore.

The ore transfer dock at Contrecoeur now handles the trans-shipment of imported overseas ore only. As the following table shows, the quantity of this ore has tended to fall.

	St. Lawrence Section		Welland Section	
	Imports (tons)	Imports (%)	Imports (tons)	Imports (%)
1954	106,971	36.0	n.a.	n.a.
1955	54,594	3.1	n.a.	n.a.
1956	62,767	2.4	n.a.	n.a.
1957	12,908	0.5	n.a.	n.a.
1958	-	0.0	n.a.	n.a.
1959	396,441	6.3	n.a.	n.a.
1960	963,852	22.3	932,634	22.0
1961	733,251	19.3	682,150	18.7
1962	628,064	10.6	628,064	9.9
1963	453,554	5.6	450,181	5.4
1964	436,751	3.6	433,031	3.4

The decline is of course more marked if the quantity if measured as a percentage of the total upbound movement.

IRON ORE ORIGIN AND DESTINATION

J. Kates and Associates conducted a detailed study of the origin and destination pattern of ore shipments in the Great Lakes area for the years 1960 - 1964. This was made possible by data supplied by the St. Lawrence Seaway Authority of Canada, supplemented by statistics of the U.S. Army Engineer Corps, the Dominion Bureau of Statistics, the Department of Mines and Technical Surveys (Canada) and individual company sources. The results of this survey are shown in Table Nos. 13 - 22.

The choice of Great Lakes receiving ports for ores shipped from Sept Iles and Port Cartier is fairly well established but may vary significantly from year to year. For example, shipments from Port Cartier have tended to proceed to the ports of Detroit, Lorain and Conneaut and more recently Chicago and Gary. Movement of ore from Sept Iles has been largely to the ports of Cleveland, Ashtabula, Detroit, Toledo and Buffalo. Thus I.O.C.C. shipments from Sept Iles through the Seaway are destined almost exclusively for U.S. Lake Erie ports, whereas Quebec Cartier ore shipments to U.S. Lake Michigan Ports have grown rapidly in the past two years and now exceed shipments to U.S. Lake Erie ports.

Table No. 23 clearly illustrates the growing importance of Seaway ore to the ports located along the shores of both Lake Erie and Lake Michigan. In the last five years the Seaway has succeeded in pushing its

share of total ore receipts at Lake Erie ports from 8.3% to 17.6% and at Lake Michigan ports from 0.3% to 11.8%.

No tariff is imposed on the movement of iron ore and this product is no respector of political boundries, particularly within the Great Lakes System. Evidence of this can be seen in the fact that very little Quebec/Labrador ore has moved to the steel mills of Hamilton who have received practically all their supplies from the Mesabi range.

The heading "Other St. Lawrence Ports" in the tables includes the ports of Montreal, Trois Rivières, Quebec, Baie Comeau and Bell Island, but can be read as "Contrecoeur", since this port makes up 85% of the total. This column therefore can be taken to represent imports of foreign overseas ore into the Great Lakes System. The only exception to this would be shipments from Bell Island which amounted to 22,834 tons for the period 1960 - 1964. Other shipments for the same period were as follows:-

Baie Comeau	61,271 tons
Quebec	39,465 tons
Trois Rivières	133,461 tons
Montreal	201,255 tons
Unclassified	16,552 tons

The above ore is probably all foreign overseas ore transshipped at these ports.

FINAL DESTINATION

What is the final destination of Quebec/Labrador ores shipped via the St. Lawrence Seaway?

This is a difficult question to answer since in many cases it is unknown to the shipper. For example, Quebec Cartier concentrate is mostly sold f.o.b. Port Cartier and the choice of routes and carriers is determined by the customers. Furthermore, much ore is stored at the port of destination and is shipped inland as required. It is however possible to establish roughly the area served by shipments of Quebec/Labrador iron ore through the Seaway since the location of blast furnaces of participating companies is known.

These details, together with a study of present comparative transportation costs (See Chapter IV) lead us to believe that final destinations for these ores are approximately as set out below. These assumptions have been strengthened in many cases through discussions with company officials and from information contained in the annual "Directory of Iron and Steel Works of the U.S. and Canada".

A. From Sept Iles (I.O.C.C.)

- Cleveland - Mostly consumed by Republic Steel Corp. who operate six blast furnaces in Cleveland (1960 capacity 2,708,000 tons), one in Massillon (1960 capacity 266,000 tons) and one in Canton (1960 capacity 266,000 tons). Some shipments may proceed to Weirton W. Va. (National Steel)

and Steubenville, Ohio (Wheeling Steel Corp.) from this port.

- Ashtabula - Mostly consumed by Republic Steel Corp. who operate five blast furnaces at Youngstown (1960 capacity 1,773,000 tons) and one at Niles (1960 capacity 630,000 tons). Some ore is shipped to Youngstown Sheet and Tube who operate four blast furnaces at Campbell, Ohio with a 1960 capacity of 1,452,000 tons and two at Youngstown with a capacity of 504,000 tons.

- Detroit - Mostly consumed by Great Lakes Steel Corporation (a subsidiary of National Steel) who operate four blast furnaces at River Rouge, Michigan (capacity 2,600,000 tons) and by the Ford Motor Company (3 blast furnaces).

- Toledo - Probably consumed by Armco Steel Corporation at Middletown and Hamilton, Ohio (3 blast furnaces with a combined capacity of 1,458,000 tons).

- Buffalo - Mostly consumed by Republic Steel who own two blast furnaces in that city (capacity 683,000 tons). In 1964 over half a million tons were shipped to Bethlehem Steel at Lackawana (seven blast furnaces; capacity 3,590,000 tons). This is a result of this company's increased participation in the Carol pellet project.

In addition all shipments to Hamilton have been for the account of STELCO. Shipments to Huron may proceed to Ashland, Kentucky where Armco Steel Corporation operates three blast furnaces with a combined capacity of 1,058,000 tons.

B. From Port Cartier (Quebec Cartier Mining)

Detroit - Concentrate is probably shipped 100% to the Ford Motor Company in Detroit. National Steel Corporation and Great Lakes Steel Corporation also have blast furnaces in the vicinity but these companies are tied in with the Hanna group.

Conneaut, Ohio - Shipments to this port are probably consumed 100% by U.S. Steel who operate blast furnaces in the following accessible locations:

Location	No. of Blast Furnaces	Pig Iron Capacity
Braddock, Pa.	Six	2,707,000 tons
Rankin, Pa.	Six	2,503,000 tons
Duquesne, Pa.	Five	1,497,000 tons
Youngstown, Ohio	Four	1,611,000 tons
McKeesport, Pa.	Four	1,375,000 tons
Clairton, Pa.	One	366,000 tons

The Bessemer and Lake Erie Railroad* has direct connections with the Pittsburgh area from this port.

Lorain, Ohio - Consumed 100% by U.S. Steel who operate five blast furnaces in this city with a combined annual capacity of 2,160,000 tons of pig iron.

* Subsidiary of U.S. Steel.

Gary, Indiana - Consumed 100% by U.S. Steel who operate twelve blast furnaces with a combined annual capacity of 5,466,000 tons of pig iron.

Chicago, Illinois - U.S. Steel Corporation operates eleven blast furnaces with a combined annual capacity of 4,454,000 tons of pig iron at South Chicago.

Cleveland, Ohio - U.S. Steel Corporation operates six blast furnaces in this city with a combined annual capacity of 2,708,000 tons of pig iron.

PENETRATION OF SEAWAY ORE

The foregoing analysis reveals that iron ore and concentrate moving through the St. Lawrence Seaway reach most of the important blast furnace facilities along the Great Lakes including the Chicago area and large areas of Western Pennsylvania, Eastern, Central and South Western Ohio as well as Weirton, W. Va. and possibly Ashland, Ky. This area (excluding Johnstown, Pa. and locations further East) accommodates approximately 67.1% of total pig iron capacity in the United States, based on 1960, the last year the American Iron and Steel Institute published capacity figures. If only member companies of the Iron Ore Comapny of Canada, Quebec Cartier Mining and Wabush Mines based in this area are included, the percentage would be 59.3% of total U.S. pig iron capacity. (See Table No. 24 and page 57).

The only Canadian centre which received significant quantities of Seaway iron ore during the period 1960 - 1964 was Hamilton. Pig iron capacity in Hamilton was 3,485,000 tons in 1963 - 1964 or 50.5% of total Canadian capacity of 6,905,000 tons.

CHAPTER III

EXPECTED DEVELOPMENT OF SEAWAY TRAFFIC IN IRON ORE

Before the Seaway agreement was concluded in 1954, several agencies made estimates of future Seaway traffic. A number of other estimates were also made subsequent to that date and we list below some of these forecasts as they pertain to movements of iron ore:-

Author		Quantity (millions of tons)	Forecast Year
U.S. Dept. of Commerce (1948) (min. estimate)	House Public Works Committee Hearings	30.0	1964 - 69
Canadian Dept. of Trade & Commerce (1951)	The St. Lawrence Waterway & the Can. economy	20.0	1964 - 69
St. Lawrence Seaway Development Corp. (1954)		10.5	1959
Great Lakes St. Lawrence Association (1954)		20.0	1964 - 69
U.S. Army Engineers Corps 1958	Iron Ore Traffic Analysis	42.7	1983
Dept. of Mines and Technical Surveys (Can) 1960	Mineral Information Bulletin MR 40	15-25	1970
Dept. of Mines and Technical Surveys (1962)	MR1 131/62 (Internal Report)	22.5	1970
Dept. of Mines and Technical Surveys (1963)	MR1 202/63 (Internal Report)	16.3	1970

In the first chapter we suggested that total North American requirements of iron ore and concentrates should increase from 135.4 million tons in 1963 to about 163 million tons in 1972, and to roughly 194 million tons in 1980. However, demand for iron ore in the Great Lakes region will probably increase in proportion to the growth of steel and particularly blast furnace capacity in this area. This may be either greater or less than the national average, resulting in a parallel shift in demand for iron ore, or it may be similar, in which case the demand for iron ore at Great Lakes ports should tend to follow the continental pattern. The next section discusses the regional growth of steel and iron making capacity in the United States and Canada and compares this with the development of iron ore receipts at the major Lake ports as a percentage of total consumption in North America. This analysis is then used as a basis for making an estimate of the future passage of iron ore through these ports.

The final portion of this chapter will determine the quantities of these requirements which will be filled by ore proceeding through the St. Lawrence Seaway.

REGIONAL GROWTH OF STEEL AND BLAST FURNACE CAPACITY

Steel making capacity developed as follows to January 1, 1960, the last year capacity figures were collected in the United States. Figures are in millions of tons.

District	1920	1930	1940	1945	1950	1955	1960
Pittsburgh-Youngstown	30	33	34	40	39	44	51
Chicago	11	16	18	21	21	28	33
Eastern	14	14	15	18	20	27	31
Cleveland Detroit	4	6	7	8	9	13	16
Western	1	2	2	5	6	7	9
Southern	2	2	3	4	4	7	8
TOTAL	62	73	79	96	99	126	148

This may be expressed inpercentage terms as follows:-

District	1920	1930	1940	1945	1950	1955	1960
Pittsburgh-Youngstown	48.0	44.6	42.9	41.8	39.4	35.2	34.2
Chicago	18.3	21.4	22.9	21.7	20.9	22.1	22.0
Eastern	21.7	19.4	19.7	18.9	20.0	21.1	20.8
Cleveland-Detroit	6.3	8.6	8.4	8.1	9.4	10.4	10.9
Western	2.9	2.7	2.6	5.1	5.7	5.6	6.4
Southern	2.8	3.3	3.5	4.4	4.6	5.6	5.7

The American Iron and Steel Institute no longer provides capacity data although the Wall Street Journal estimated that 1964 U. S. Steel Ingot capacity was in the neighbourhood of 165 million tons.

More important from the point of view of ore requirements is the development of blast furnace capacity. The following percentage figures are developed from Table No. 24 and are given to illustrate the relative growth of various regional locations in the United States since 1948.

The breakdown is made according to the same A.I.S.I. districts given above regarding steel capactiy but is somewhat more detailed.

Location	1948 %	1954 %	1960 %
Kentucky (Ashland)	1.1	1.0	1.1
Ohio (Youngstown area)	9.6	8.2	7.1
Ohio (Central and South)	3.3	5.1	4.9
Pennsylvania (Pittsburgh area)	15.4	12.8	11.9
Pennsylvania (Western, excl. Pittsburgh)	9.1	8.6	8.1
W. Virginia (Weirton and Benwood)	2.2	2.7	2.7
Total Pittsburgh - Youngstown District	40.7	38.4	35.8
Illinois (Chicago and Granite City)	9.1	8.6	8.3
Indiana (E. Chicago, Gary)	11.8	10.6	10.7
Duluth, Minnesota	0.9	0.7	0.7
Total Chicago District	21.8	19.9	19.7
Michigan (Detroit area)	2.4	3.4	5.5
Ohio (Lake area)	7.2	7.2	7.3
Total Cleveland - Detroit District	9.6	10.6	12.8
Maryland (Sparrows Point)	4.8	5.0	5.7
Massachusetts	0.3	0.3	0.2
New York (Buffalo dis. & Troy)	6.4	6.5	6.2
Pennsylvania (Eastern)	5.2	6.9	7.3
Total Eastern District	16.7	18.7	19.4
Total Western District	3.9	4.8	4.9
Total Southern District	7.3	7.6	7.4
Grand Total All Districts	100.0	100.0	100.0

The foregoing data indicates that districts generally receiving supplies of iron ore through Great Lakes ports, namely the Pittsburgh-Youngstown, Chicago and Cleveland-Detroit areas plus Buffalo have tended to lose ground in recent years. Steel capacity in these regions dropped from 71.6% of the total in 1945 to 67.1% of the total in 1960, whereas regional blast furnace capacity declined from 77.6% in 1948 to 73.8% in 1960. It is interesting to note that the Chicago District has tended to lose ground as far as blast furnace capacity is concerned but has tended to increase its share

of steel making capacity. According to Table No. 24, total blast furnace capacity of this area has grown from 52,380,000 tons in 1948 to 71,154,000 tons in 1960. Of particular interest is the fact that steel companies participating in Quebec/Labrador iron ore facilities controlled 80.4% of 1960 capacity (57,182,000 tons).

In Canada there has been a tendency for steel and blast furnace capacity to increase relatively in the Great Lakes area (i.e. Ontario). However, the shift has been slight and not significant owing to the small scale of the Canadian industry. Blast furnace capacity of those plants situated along the Great Lakes is presently as follows:-

Location	Blast Furnaces	Capacity (Tons per year)
Sault Ste. Marie (Algoma)	Four	2,000,000
Port Colborne (Algoma)	One	210,000
Hamilton		
(Stelco)	Four	1,935,000
(Dofasco)	Three	1,550,000

It is reported that during the next five years these companies plan to spend an estimated $750 million which will boost capacity 30 - 40% by 1970. The details of these expansion plans are not available at time of writing but it is known that there will be heavy capital outlays for new blast furnaces and associated services to increase iron making capacity.

These plans may bring blast furnace capacity of this region to between 7.5 and 8 million net tons per year by the early seventies.

TRENDS AT GREAT LAKE PORTS

These regional patterns of growth in steel and iron making capacity can be expected to have an effect on the importance of the Great Lakes area as a market for iron ore. Table No. 31 illustrates the receipts of iron ore at the major Great Lakes ports during the period 1951 - 1963. The following data will illustrate the importance of this Lake ore as a percentage of the total consumption of iron ore in the United States and Canada for the years 1951 - 1963. Figures are in millions of tons.

	North American Consumption of iron ore	Total Receipts of Iron ore at Lake ports	Percentage of Total Consumption
1951	133.9	91.2	68.1
1952	118.4	77.7	65.6
1953	142.7	98.8	69.2
1954	110.5	67.5	61.1
1955	146.3	97.0	66.3
1956	147.6	83.8	56.8
1957	151.7	97.0	63.9
1958	108.3	60.7	56.0
1959	111.8	50.3	45.0
1960	129.3	82.3	63.7
1961	119.6	68.0	56.9
1962	120.0	70.8	59.0
1963	135.4	74.3	54.9

As expected there has been a tendency for the importance of Lake Ports to decline over the past decade. The rate of decline is rather greater than might be expected from trends in steel and iron making capacity alone and may be explained by the increased use of beneficiated ore and particularly by the sharp increase in the quantities of overseas ore

consumed in the Maryland/Eastern Pennsylvania iron producing region during the period 1954 - 1960.

During the last three years there has been some notable expansion in blast furnace facilities in the Great Lakes area. In fact all new capacity has been concentrated in this region. The following developments should be mentioned.

1) Jones and Laughlin Steel Corp. has built a new 29 ft. hearth diameter furnace at their Cleveland works. Expected production is in the neighbourhood of 900,000 tons per annum. This company has also announced plans for similar blast furnaces at Aliquippa and Pittsburgh.

2) United States Steel has completed the largest blast furnace in the Pittsburgh area at Duquesne with an annual production of 850,000 tpy.

3) Armco Steel Corp. at Ashland, Ky. has built what is probably the largest blast furnace in the United States with a production of about 1,200,000 tpy.

In addition to this, Table No. 33 gives some indication that imports from Africa and South America have begun to level off. These shipments are generally made through Atlantic coast ports. For example, imports from Venezuela, the most important supplier of iron ore to the United States after Canada, grew substantially from 1954 - 1960 when they reached a high of 14,556,000 gross tons. However, in the following three years there was a steady decline to 9,327,000 gross tons in 1963.

We believe these factors may combine to give a boost to the receipts at Great Lakes ports sufficient to stabilize their share of iron ore receipts to about 55% of total North American consumption for the foreseeable future.

FUTURE RECEIPTS OF IRON ORE AT GREAT LAKES PORTS

The quantities of ore required at Great Lakes ports for the years 1972 and 1980 have been estimated as follows: (millions of tons)

	1972	1980
U.S. Lake Erie	59	70
U.S. Lake Michigan	24	28
Canadian Lake Ports	7	9
Total	90	107

These forecasts have been made under the following assumptions:

1) There will be no significant regional changes in rates of growth in the Great Lakes area as regards steel or pig iron capacity.

2) Great Lakes ports will continue to handle roughly 55% of total iron ore requirements of the United States and Canada.

3) Canadian blast furnace capacity in the Great Lakes area will increase 35% to 1972 and a further 20% to 1980.

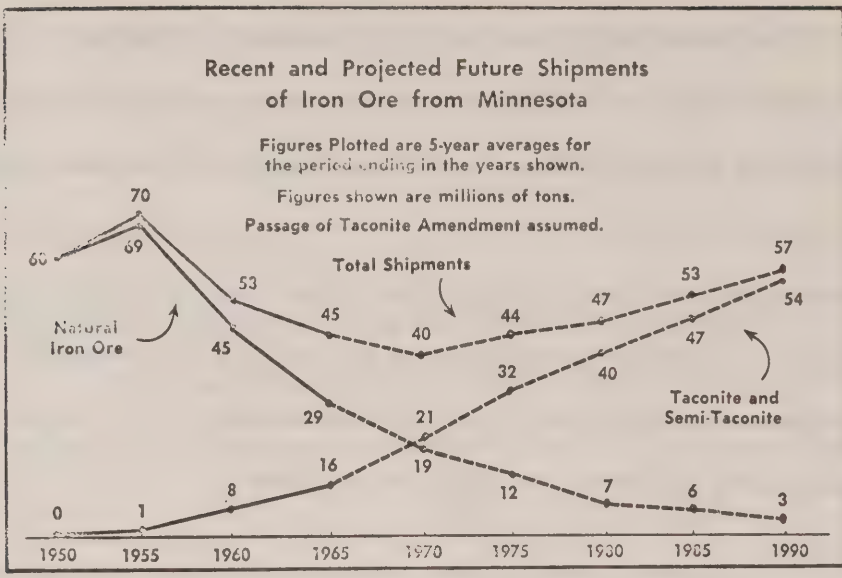
The absence of any expected significant changes in regional growth rates (point No. 1 above), permitted a Lake breakdown on the basis of the historical data of Table No. 31. The average regional intake of iron ore for the years 1951 - 1964 was used except that additional weight was given to the more rapid developments expected along the Canadian Lakes over the next several years.

The above requirements will be primarily satisfied by shipments originating in the U.S. Lake Superior region supplemented by Canadian shipments and imports. The Canadian shipments will originate either from the Ontario/Western Quebec area in which case they will be shipped either all rail or rail and thence ship via the Great Lakes or they will proceed from the St. Lawrence and Gulf region through the St. Lawrence Seaway. Imports will likely continue to be transshipped at Contrecoeur before travelling via the Seaway to Great Lakes ports.

The recent history of iron ore in the United States and Canada (See Table No. 35) shows that this traffic will become increasingly made up of concentrate and pellets and there appears no doubt that the regional future of the iron ore industry will largely be decided by future development of pellet and concentrate capacity. The following sections will discuss the development potential of each source of supply mentioned above.

REGIONAL DEVELOPMENT OF IRON ORE PRODUCING AREAS

In Minnesota, the Citizens Committee for the Taconite Amendment (passed in November 1964) prepared an-estimate of the trends in shipment of natural iron ore and taconite pellets from Minnesota during the next twenty five years. The estimate is illustrated on the following chart:



This chart clearly illustrates the gradual demise of natural ore shipments from Minnesota to 1990. It also anticipates that total shipments of all types of ore will fall to 40 million long tons (45 million short tons) by 1970 after which they will rise to 47 million long tons(53 million short tons) in 1980 and 57 million long tons (64 million short tons) in 1990. This forecast is possibly a trifle low and in the words of Professor Pfleider represents "the minimum goal of this state" (Minnesota). We therefore use these figures not as total production but as total shipments from Great Lakes ports, i. e. we disregard direct rail movements which traditionally total under 5% of production.

If we assume a similar pattern of development in the neighbouring states of Michigan and Wisconsin, this would appear to offer excellent prospects for the growth of shipments from the Canadian side of the border,

i.e. from Ontario and Quebec/Labrador. In terms of tonnage this could possibly involve a quantity of around 28 million tons in 1972 and 36 million by 1980.

Origin of Ore	1972 (approx. tons)	1980 (approx. tons)
Minnesota*	47	53
Mich/Wis*	15	18
Balance	28	36
Great Lakes Ports	90	107

Michigan and Wisconsin shipments are estimated on the assumption that these areas will continue to supply roughly 25% of total U.S. Lake Superior shipments (See Table No. 36). The balance will be filled almost entirely by Canadian ore of which the greater part will originate from St. Lawrence Gulf ports and travel by water.

Table Nos. 18 - 22 showing the origin and destination pattern of shipments of iron ore in the Great Lakes area for the period 1960 - 1964 already show a definite fall in the percentage of ore received at Great Lakes ports which originated in the U.S. Great Lakes region. The pattern has been as follows:-

Receipts at Great Lakes ports by Origin

Year	U.S. Great Lakes %	Canadian Great Lakes (excl. Picton) %	Eastern Canada via Seaway (incl. Picton) %	Imports via Seaway %
1960	89.3	5.1	4.5	1.1
1961	87.9	5.7	5.3	1.1
1962	84.7	6.2	9.2	0.9
1963	82.8	5.9	10.7	0.6
1964	79.3	6.0	14.1	0.6

* All U.S. Lake Superior production assumed used up in the Great Lakes area.

We hesitate to establish a quantitative forecast on the basis of a five year period but the figures certainly indicate a strong trend towards increased use of Eastern Canadian ore in the Great Lakes region. Whether the **degree** of this trend will be maintained is difficult to say but it is almost certain that further participation of upbound Seaway ore will be seen in the years ahead, probably 23 - 25% by 1972 when all mines in the Quebec/Labrador region have passed the development stage and achieved their natural rhythm of production with stabilized markets for their products. Imported ores will likely increase rather than decrease in future since the Iron Ore Co. of Canada plans to embark on a big promotion campaign to develop their ore transfer dock at Contrecoeur as a vehicle for moving imported ore to Lake ports. The Canadian Great Lakes region (i. e. Ontario) will undoubtedly increase its participation to between 7 - 8% by 1972 and to perhaps 9 - 10% by 1980.

Before submitting further support for these figures, we would like to translate them into quantitative tonnage terms rather than percentages as follows:-

Origin of Ore	1972	1980
U.S. Great Lakes	62	71
Canadian Great Lakes	7	10
Seaway Ore	21	26
Total Great Lakes Ports	90	107

These figures are of course approximate but we feel they are reasonable in the light of present developments and those expansion plans which are already known. These plans are discussed in the next section.

PRESENT AND FUTURE EXPANSION PLANS

As far as the Quebec/Labrador region is concerned, the outlook is encouraging and the following developments can be mentioned:

1) It is variously reported that a study is being conducted to determine the feasibility of undertaking the construction of a plant to beneficiate and perhaps pelletize Shefferville direct shipping ore. This plant may be a completely new venture or could be based on expansion of facilities at Carol Lake. A green light for such a project would almost certainly reverse the declining trend evident in recent sales of Shefferville direct shipping ores.

2) Labrador Mining and Exploration Co. Ltd. plans to start its own operation on the tonnage of iron ore it retains at Carol Lake. It is possible that a 4 million ton beneficiation plant may be in operation by 1970/72 which could ultimately increase to 6 million tons by 1980.

3) It is also considered likely that Quebec Cartier Mining Co. will build a pellet (or possibly a sinter) plant of about four million tons capacity within one or two years.

4) All three producers plus the two pellet companies already have built-in facilities to increase capacity should the need arise.

- I.O.C.C. (Shefferville). Provision was made to increase expected annual production of 10 - 12 million tons to 20 million tons of direct shipping ores should the need arise.

- I.O.C.C. (Labrador City). An adjacent ore-body, the Carol East is being developed to supplement the Smallwood ore-body in the future. Present concentrate production of 7.8 million tpy can be increased if required.

- Carol Pellet Co. Provision was made for a substantial increase in present capacity of 6.2 million tons if required.

- Quebec Cartier Mining Co. Mining, concentrating and dock installations were designed to facilitate a substantial increase from the present 9 million ton capacity.

- Wabush Mines has made provisions for increasing concentrate capacity from the present 5.9 million tons to 11.2 million tons annually.

- Arnaud Pellet Co. has built-in facilities to increase capacity from the present 5.5 million tons per annum.

5) The Management of Mount Wright Iron Mines Ltd. has submitted formal sales proposals to British and West German steelmakers in a bid to launch a $80 million mine-concentrator-pelletizing plant project. Annual capacity of over four million tons of pellets is projected by 1969. Although oriented toward Europe, some of this material could be channelled down the Seaway.

Further development can be expected within the next 5 - 10 years by a number of other companies who own properties or leases in the area. As soon as satisfactory markets are available the following ventures could get under way.

Albanel Minerals Ltd. owned jointly by Cleveland Cliffs and M. J. O'Brien maintains a property containing 116 mining claims in the region of Lake Albanel north of Chibougomau.

Ungava Iron Ore Co. owned by associated Canadian and American firms and five West German steel firms is studying the feasibility of developing mining sites on the west side of Ungava Bay. It is reported they are planning to sell some concentrate through Lake ports although the bulk of sales would be in the European market.

Jubilee Iron Corp. is exploring claims in the vicinity of Mount Wright north of Gagnon.

Other areas in Quebec and Labrador are being investigated by the Iron Ore Co., Hollinger North Shore Exploration Co., Canadian Javelin, etc. Iron ore is present in abundance but most new ventures will probably have to look away from North America for markets.

The Ontario iron mining district (including Hilton Mines in Western Quebec) is presently in transition and will probably emerge as a strong supplier of high grade products. In the last ten years a number of concentrate and pellet plants have been built and two new pellet plants have been announced by Caland Ore and Strathagami Mines respectively (See Table No. 27). Within three years total pellet capacity should reach about six and a quarter million gross tons per annum. Sinter capacity is now over 2 million gross tons and Steep Rock Iron is shipping about 250,000 gross tons of concentrate per annum.

New developments that could take place over the next few years include:-

- Anaconda Iron Ore (Ontario) Ltd., have finished exploring deposits near Nakina. A pellet plant has been proposed.

- Can-Fer Mines who wish to develop a mine and 1,000,000 ton pellet plant. The outcome will depend on success of negotiations with potential consumers.

- It has just been announced that Steep Rock Iron is negotiating contracts with Algoma Steel Corp., Detroit Steel Corp. and other steel companies for the sale of up to 5 million tpy of pellets. An eventual plant would be based on the outcome of present discussions.

- The St. Joseph properties of Steep Rock Iron Mines Ltd. may be developed to supply pellets for Stelco in Hamilton.

- Taconite Lake Iron, a subsidiary of Pickands Mather recently announced it has exercised its option to lease the Bruce Lake property of Iron Bay Mines. This should hasten the development of this property, located in the Kenora District near Red Lake.

- Kukatush Mining Corp. (1960) Ltd. has conducted pilot plant concentration and pelletizing tests with reportedly good results.

- Pickands Mather and Stelco have an interest in Mattagami Mining Co. Ltd. A substantial tonnage of iron bearing material producing a good concentrate is available, north of Cochrane.

It is of course very difficult to plot future growth of the various iron producing regions. Much will depend on corporate ownership patterns and policies pursued by the steel companies participating in the various projects involved.

DIRECTIONAL MOVEMENT OF IRON ORE

This section will discuss traffic development in terms of its direction, whether upbound or downbound.

At the present time upbound shipments make up the major volume of traffic and this will continue and even increase. Present downbound movements are almost entirely due to use of Minnesota ores by blast furnaces located at Hamilton and these shipments will begin to taper off starting in 1965 when consumption will be switched to pellets from the new Wabush development. Receipts at Hamilton are expected to develop as follows: (in millions of tons).

	1964		1966		1969/70	
	Down	Up	Down	Up	Down	Up
Stelco	2.55	negl.	1.50	1.25	1.75	1.50
Dofasco	1.55	negl.	.90	.80	-	1.00
Total	4.10	negl.	2.40	2.05	1.75	2.50

By 1969/70 Dofasco should be receiving a good portion of its supplies from the 1,000,000 ton Strathagami pellet plant which will have a depressing effect on Seaway traffic and particularly on downbound traffic. It is considered likely therefore that by 1969/70 Hamilton will be receiving somewhat more iron ore through the St. Lawrence canal system than through the Welland Canal. Overseas exports of iron ore through the St. Lawrence Seaway are not considered likely to develop and on this basis we believe iron ore movements will assume the following directional pattern (in millions of tons).

	Welland Section		St. Lawrence Section	
	Upbound	Downbound	Upbound	Downbound
1972	19	2	21	negligeable
1980	23	3	26	negligeable

The anticipated growth of iron making capacity at Hamilton of roughly 35% to 1972 and an additional 20% to 1980 is taken into account in developing these figures. Furthermore, shipments upbound from Picton, Ont. are estimated to average about 800,000 tons annually during the 1970's.

It should be emphasized that the effect of Stelco buying proportionately greater quantities of their requirements from Quebec/ Labrador than from Lake Superior will have a double effect on traffic in that it will tend to increase volume on the St. Lawrence section and decrease volume on the Welland section by an equal amount. It is therefore conceivable that the St. Lawrence section could carry a higher volume of iron ore than the Welland Section in the future. For purposes of this analysis however, we have assumed that tonnage on the two canal systems will be about equal as of the year 1969 or 1970 when the Strathagami pellet plant is brought into full production.

CHAPTER IV

POSSIBLE COMPLICATING FACTORS AND THEIR EFFECTS ON SEAWAY IRON ORE TRAFFIC

The first chapter briefly touched upon the development of pre-reduction and direct reduction techniques and their possible influence on future demand for iron ore. This chapter explores certain other factors which have a more direct bearing on the Seaway transportation link in the movement of iron ore.

Considerable significance must be given to the effect of possible changes in rail and ocean freight rates on the cost advantage of the Seaway route over alternate routes via Atlantic ports. This is particularly important in the borderline Western Pennsylvania district which currently receives iron ore via the St. Lawrence Seaway.

Other potential developments briefly discussed in this chapter include comparative cost considerations, and the effect of the new Soo Lock, while certain other factors which may have an influence on traffic in the more distant future are also appended. These include year round lake transportation, unit train, barge train and pipeline carriage of iron ore from the Lakehead, and further growth of oversea ore deposits.

FREIGHT RATES AND THE ST. LAWRENCE SEAWAY

In Chapter II we noted that iron ore and concentrate is currently carried via the St. Lawrence Seaway to Conneaut and from there

by rail as far east as the Pittsburgh area. There are indications however, that Johnstown and Monessen are perhaps better served by the Atlantic coast route at the present time, i. e. the cut-off point as far as Seaway ore is concerned now lies somewhere between Pittsburgh and Monessen/ Johnstown.

This is perfectly understandable on the basis of present costs of transportation which are as follows:-

Cost Elements U.S. $ per long ton	Pittsburgh district via Seaway	via Atlantic	Monessen via Seaway	via Atlantic	Johnstown via Seaway	via Atlantic
Water freight	1.48	0.90	1.48	0.90	1.48	0.90
Transfer at receiving Port	0.50	0.55	0.50	0.55	0.50	0.55
Rail Freight (Jan. 1st, 1965)	2.73	3.76	2.86	3.62	3.02	3.50
Toll Charge*	0.45	-	0.45	-	0.45	-
Total	5.16	5.21	5.29	5.07	5.45	4.95

On the face of it, costs to Pittsburgh are only slightly more via Atlantic ports, but in cases where ore is stockpiled, the transfer costs are $0.35 per gross ton higher at Atlantic ports than at Lake ports.

	Lake	Atlantic
Transfer to stockpile	0.77	1.05
Dock stockpile to car	0.31	0.38

We should mention that the water freight rates given are the estimated current charter rates and these can vary depending on the size and type of ship.

* $0.40 per net ton plus $0.04 per gross registered ton of the vessel, paid 29% in U.S. and 71% in Canadian currency. It is assumed that the average ore carrier transports twice the tonnage of iron ore as its gross registered tonnage.

Rates via Atlantic ports in "captive" vessels owned by the steel companies are considerably higher and may run up to $1.60 per gross ton* compared to the present $0.90 per gross ton charter rate.

It is very difficult to predict the future development of the water and rail freight rates but some general observation can be made.

Water Freight Rates

Water freight rates have declined considerably over the past several years. For example the rate from Sept Iles to Lower Lake ports when the Seaway opened in 1959 was about $2.00 per gross ton. This declined sharply in 1963 as a result of action by one company and for a time went as low as about $1.30 before settling to the present level. It is generally considered unlikely that rates will go lower in the foreseeable future since the size of vessels is limited by the size of the Seaway locks**. Seaway rates for iron ore are indirectly influenced by grain movements since in many cases vessels use the iron ore traffic to position themselves for picking up grain at lake ports for the return trip to Montreal or Baie Comeau.

The water rate to U.S. East Coast ports has declined drastically since 1954 when charter rates were in the neighbourhood of $1.50 -

** One company official estimated that vessels of 14,000 tons (but not below), probably break even at the current $1.60 rate average.

* I. E. Gross cargo tonnage.

$1.60 per gross ton. The introduction of larger vessels such as the 45,000 ton Cosmic brought the rate down to present levels before the Seaway opened and they have remained relatively stable since then. Most shipping authorities foresee no further reduction for some time to come. They point out that even with larger vessels in the 100,000 ton class, rates may not fall due to a slowly rising charter market and to the fact that the cost benefits to be had from an increase in capacity, while great in the 10,000 - 25,000 ton range, fall off rapidly above 45,000 tons*. Furthermore, since a steel works generally buys its raw materials from a number of different sources, few of which are able to handle ships over 25,000 tons deadweight, most ocean carriers will probably continue in this class for a number of years.

Rail Freight Rates

Rail rates in the United States are controlled by the Interstate Commerce Commission and are published. As far as rates from Lower Lakes ports to consuming centres are concerned, there have been seven general revisions since 1951 - all upwards. The total increase has been in the neighbourhood of 40 - 50%. Handling charges have also increased substantially in recent years.

The rates on a ton-mile basis are much higher for Lower Lake consuming centre routes than for the east coast consuming centre routes. The same railroad companies own the railways serving both areas, and this situation has been in effect for a long time owing to the tie in of

* See study by Royal Netherland Blast Furnaces and Steelworks Ltd. 1958.

these companies with East Coast port interests. It is difficult to say whether any adjustment will be made in future but it is significant that Lake ports have recently become more aware of certain rate anomalies. For example, the port of Toledo commissioned a study, completed in early 1964, which attempts to highlight a number of significant rate differences which, it is claimed, favour East Coast interests. A recent series of hearings on problems of the St. Lawrence Seaway by a subcommittee of the U.S. Senate also heard testimony to this effect.

If Lake ports can obtain adjustments which include iron ore, this could have a favourable effect on Seaway traffic, though probably only insofar as shipments to Johnstown and Monessen are concerned. Any change in the rate structure (water or rail) which would have the opposite effect could seriously reduce the quantity of ore moving via the Seaway since it could eliminate the Pittsburgh district.

Imports

Imports of overseas ore travelling to the Chicago district will probably continue to proceed via the Seaway. The following is the present rate structure.

via Baltimore (per gross ton)		via Seaway (per gross ton)	
Vessel to car	0.55	Extra sea freight to Contrecoeur	0.80
Rail freight to Chicago	6.40	Discharge	0.75
		Charge to laker	0.20
		Seaway freight to Chicago	2.00
		Toll	0.44
		Discharge at Chicago	0.50
Total	6.95		4.69

We have mentioned that the Iron Ore Co. of Canada is currently endeavouring to promote the use of its ore transfer facilities to handle foreign ore. It is possible that foreign ore shipments through the Seaway could rise to 750,000 - 1,000,000 tons over the next few years.

COMPARATIVE COST OF PRODUCTION

Comparative costs of production must clearly be a major factor affecting the development of a particular mining region even in cases where a few major companies control competing regions, e.g. Eastern Canada and Lake Superior.

It is of course very difficult to make meaningful quantitative cost comparisons between individual ore deposits and beneficiation processes due to the large number of factors going into such costs such as labour, taxes, development, interest, etc. It is generally considered however, that costs and productivity in Canada are favourable compared to companies operating in the United States. This statement is substantiated in some measure by the fact that during the period 1954 - 63 the Iron Ore Co. of Canada generated a cash flow of approximately $175 million and reduced bond indebtedness by approximately $80 million, all during a period of expansion. Mr. John Hammes in a paper * delivered to the annual meeting of the A.I.M.E. in Chicago, February 17th, 1965 presented an analysis of various operating and capital costs of producing and beneficiating iron ore in Minnesota, Michigan

* An Analysis of Technological and Economic Factors Affecting the Future Production of Minnesota Magnetic Taconites.

and Eastern Canada. His data given below suggests that Quebec/Labrador may have the lowest cost of the major mining regions.

	Minnesota 61% Fe $/ton	Michigan 63% Fe $/ton	Quebec/Labrador 65% Fe $/ton
Mining	1.95	1.40	1.07
Beneficiation	2.64	2.48	0.84
Agglomeration	1.25	2.27	2.30*
General	0.90	0.50	0.65
Franchise Payment	1.00	1.51	1.91
Amortization	3.21	2.44	3.06
Total cost at shipping point	10.95	10.60	9.83
Cost per unit of iron	17.9¢	16.8¢	15.1¢

* Including regrinding.

The fact that Quebec/Labrador crude hematite and specularite ores are generally coarser, more friable and higher in iron content than magnetic taconites has important cost implications. Grinding is generally the highest cost phase of low grade concentration and increases rapidly for finer grinds (the energy required for grinding any material is proportional to the new surface produced). The nature of magnetic taconite requires grinding to pass 100 mesh (75 to 80 percent minus 325 mesh) and even to 500 mesh in one mine to effect liberation of the ore particles, whereas Quebec/Labrador crude hematite generally liberates cleanly at 20 mesh.

Unfortunately pellets are difficult to form from concentrate sized greater than about 200 mesh, since the individual grain can attach itself to the forming globule during pelletizing only through that portion of

its surface comes into contact with it. A 28 mesh particle has 64 times the surface but 512 times the weight of a 200 mesh particle which makes it considerably more difficult for these particles to adhere together. Initial grinding volume of crude taconite would be greater than concentrate used to produce Canadian pellets but magnetic taconite generates about 28% of the total heat requirement for firing the pellets from the exothermic reaction of the magnetite itself in transforming to hematite.

It is therefore not suprising that Mr. Hammes' figures suggest that cost of producing beneficiated ore (concentrate) is relatively lower in Eastern Canada though not necessarily pellets. A great deal of research is presently being undertaken to minimize the necessity of spending large amounts of energy grinding coarse grained concentrate in order to pelletize it and it is conceivable that a way may be found at some future date of reducing the cost of agglomerating iron ore concentrate in Eastern Canada. Technical breakthroughs of this kind in any mining region will of course have important implications for the future of Seaway ore traffic.

THE POE LOCK

A new lock has been under construction at Sault Ste. Marie for some time and is scheduled to open for business in July 1967. This lock will accommodate vessels up to 1,000 feet long and 100 feet wide. Present locks on the St. Lawrence Seaway take vessels up to 730 ft. in length with 75 ft. of beam and maximum draft of 25.5 ft.

Maximum cargo under current conditions is about 25,000 tons of iron ore but the new lock will allow passage of much larger vessels into Lake Michigan capable of carrying cargoes of as much as 45,000 tons. These large vessels may also of course enter Lake Erie subject to draft limitations and would be capable of transporting iron ore at ton mile costs considerably below those possible via the St. Lawrence Seaway. The use of these large vessels would clearly involve considerable modifications to existing dock and other harbour installations. However, modifications to unloading facilities may not be necessary if these large bulk carriers are designed with self-unloading features as planned. Self-unloaders would also cut port time in half, an additional cost saving factor.

These new bulk carriers may be designed to withstand winter ice conditions and this introduces the possibility of an increased navigating season or even year round navigation as discussed in the next section.

YEAR ROUND NAVIGATION ON THE GREAT LAKES

It is not difficult to imagine that the competitiveness of Quebec/ Labrador Iron ore would be severely endangered if the Great Lakes were open twelve months of the year and the St. Lawrence Seaway only seven and one half months. According to Professor H. Benford of the University of Michigan the cost of transporting a ton of ore varies almost directly in proportion to the length of the shipping season.

Winter conditions on the Great Lakes have been compared to conditions in the Gulf of Bothnia on the Baltic Sea where tankers, bulk carriers and general cargo vessels are operating the year round into the northern ports of Finland and Sweden. It is considered equally feasible to introduce year round service within the Great Lakes if economic requirements are sufficiently strong. The oil boats on Lake Michigan have already learned how successfully to operate in winter as a result of the assistance of the U.S. Coast Guard and the U.S. Weather Bureau.

The first Great Lakes Commercial bulk carrier to be constructed with winter navigation features embodied in the original design was a 4,000 ton oil tanker built in 1963 by the Sinclair Refining Co. The typical ore boat, full formed bow with vertical stern will have to undergo changes, principally below the waterline, but it is claimed that other modifications would be relatively minor. The stern treatment may simply require fin protection for the propellor and rudder, plus stronger propellor materials and cooling water intake protection. These features are not too costly when incorporated in the original plans.

The main problem for winter navigation on the Great Lakes is not ship design but ancilliary facilities such as docks, slips, harbours, locks and aids to navigation. However, several years ago the Swedes installed the first bubbler system to prevent ice formations in ships and harbours. Today, many such installations are in use through the world, e.g. at Thule, Greenland, where the docks are kept ice free during the

entire winter. Bubbler systems are feasible where the volume of underlying warm water is deep enough and extensive enough. The lack of sufficient depth appears to be a major problem in many harbours connecting channels and in the vicinity of the Seaway locks.

However, it is conceivable that future technological developments may ultimately make winter navigation throughout the Great Lakes - St. Lawrence Seaway System feasible. In the meantime, it appears that there is a greater probability of winter navigation developing on the Great Lakes some time before it is developed for the Seaway Locks and connecting channels. If this happens, the pattern of iron ore movements would be altered because internal movements on the lakes would become considerably cheaper. For instance it has been suggested that the port of Escanaba be taken as a starting point in the progressive opening up of the Great Lakes to winter navigation. This port currently ships around 5 - 6 million tons of ore annually to steel plants on Southern Lake Michigan. It is claimed that with minimum expense for conversion of equipment both ashore and afloat, ten or eleven month ore movements could be maintained allowing the same size fleet to carry up to 9 million tons of ore annually. The proposal is to use the experience gained on this run, to extend winter navigation into Lake Superior and down to the lower lakes as the necessary changes are made.

Professor Benford also foresees the year round use of a 1,000 ft. 81,000 ton self-unloading bulk carrier that would operate a shuttle service between Escanaba and lower Lake Michigan ports. However, this vessel would not venture into other Lake waters.

There seems every possibility that the entire Great Lakes system including the St. Lawrence Seaway will eventually be open to year round navigation. However, a selective development of winter navigation on the System prior to its extension to the Seaway could seriously affect iron ore shipments from Eastern Canada. It is difficult to foresee how fast or in what form the extension of winter navigation will take. However, Sen. William Proxmire (D) of Wisconsin has recently tabled a bill in the Senate calling for a study to determine how to keep the Seaway and the Great Lakes open all year. It appears likely to pass Congress this year following failure of a similar bill in 1963.

BARGE TRAINS

The operation of barge trains has been suggested as a means of greatly reducing the cost of hauling iron ore down the Great Lakes and utilizing obsolescent boats.

The proposal is to convert two ore boats into unmanned vessels and build a powerful tug to pull them. These boats would have a capacity of about 12,000 gross tons of iron ore each against 25/27,000 tons of the latest self-propelled ore boats, but the tug would require a crew of only 12 men versus around 36 on the new boats. Previous barges had 16 men crews and also required attendants for steam powered steering equipment and anchors. The newest self-propelled ore freighters cost about $8 million and it is claimed that the barge-tug combination can be set up at considerably less cost.

If it can be shown that such a procedure is workable it would clearly increase the competitive advantage of Mesabi and other Lake Superior ore. The Wilson Marine Transit Co. experimented with this type of operation during 1963 but did not have a sufficiently powerful tug to manœuvre in rough weather and the project has since been abandoned. However, ultimate success of some future scheme of this nature cannot be ruled out.

INTEGRAL TRAIN MOVEMENTS OF IRON ORE

The possibility has been advanced that integral or unit trains may succeed in displacing the ore boats carrying ore from the head of the Lakes. Iron ore now moves largely by rail to upper lakes ports before the ship movement takes over, and in some instances a second rail movement is required for final delivery.

Theoretically, integral train movements could be substituted for the present two or three leg circuits although a number of formidable hurdles would need to be overcome. The low Present and Future transport cost of lake transportation is of course the major difficulty. However, in addition, deliveries by rail would force massive and expensive changes and relocations of facilities, storage areas and material flows, particularly at Great Lake Harbours, although these expenses might be effectively counterbalanced by a variety of auxiliary benefits.

A further difficulty would be the disposal of boat capacity that unit trains would displace. It would be impractical to keep fleets on a

standby basis for very long and scrapping would soon be necessary. Their disappearance would deprive steel companies of an important competitive tool and this, along with possible need to eliminate substantial unamortized values, involve major policy considerations.

These reasons appear sufficient to exclude introduction of unit trains operations for some time to come although such movements might develop from the Lakehead to Chicago for instance. In 1964, Hanna's Pierce Group Mines at Hibbing, Minn. started shipping iron ore in a unit train to the Granite City Steel Co. at Granite City, Ill.

PIPELINE TRANSPORTATION OF IRON ORE

There has been considerable discussion in recent months regarding the possible use of pipe lines in the movement of solid bulk materials. A number of commodities have already been carried by this means and mention may be made of the Pittsburgh-Consolidation Co's. 108 mile coal slurry pipeline in Ohio, the American Gilsonite Co's. 72 mile pipe and in the case of metallic ores, the Anaconda Co's. 14 mile copper concentrates pipeline at El Salvador, Chile, in operation since 1959. It has also recently been announced that a newly formed Canadian company, Prairie Commodities Pipeline Ltd. has applied for a construction permit to build a 1300 mile pipeline to transport potash.

These developments have prompted an investigation into the feasibility of using this mode of transport to carry iron ore. For

example, the 1963 Mining Symposium at Duluth heard a proposal for a 500 mile pipeline to transport concentrate from the Mesabi range to eventual pelletizing plants located in the Chicago area. The main advantage claimed for pipeline carriage of iron ore concentrate are as follows:-

- Year round transportation and elimination of surge storage costs both at the mine site and at the steel mill site.
- Lower costs of pelletizing when done at the steel mill site due to lower costs of fuel, additives and other supplies.
- No need for extra high strength pellets to withstand transport.
- Cheap operating cost of the pipeline due to the fine size of concentrate particles (80 percent minus 352 mesh and finer). Fine particles require low pumping pressures, interior abrasion problem is insignificant and plugging of the system is minimized.

It is claimed that construction of a 10 million tpy concentrate pipeline to Chicago would require an investment of about $70 million. Total cost of transport may be as low as $1.75 per gross ton of ore based on amortization over 15 years at $17.5 million per year. This is roughly one-third of the present rail/water freight rate from the Mesabi range to Chicago. The proponents of this scheme believe that it is only a matter of time before such a scheme is developed. It is difficult to say at this point what the eventual effects this may have on the development of future Seaway traffic volume but it would presumably reduce the volume of shipments going into the Chicago area from Eastern Canada.

POTENTIAL DEVELOPMENT OF OVERSEAS ORE DEPOSITS

The potential development of overseas ore deposits will have an effect on Seaway traffic only in so far as this ore may reach the Western Pennsylvania consuming centres (and beyond) via U.S. Atlantic ports. This would happen if the price/quality of this ore and the transport costs involved are sufficient to displace some tonnage of Quebec/Labrador ore that would normally be consumed in this region.

It is not known precisely what quantity of imported overseas ore is presently consumed west of Johnstown, Pa. but it cannot be large compared to the total quantity imported through East Coast ports and generally consumed in the Eastern Pennsylvania and Maryland areas. Table No. 38 lists the areas of world expansion of iron ore production together with expected production by 1970.

We have already noted from a study of Table No. 33 that receipts of foreign overseas ore by the United States has shown a tendency to decline recently. It is difficult to determine whether this will continue except to say that political developments in these countries will probably have a marked influence on the future course of events.

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Table 1

IRON ORE: LAKE ERIE BASE PRICES OF LAKE SUPERIOR IRON ORE, BY GRADES, 1946 - 1964

(For long ton of 2,240 pounds of ore containing 51.50 percent iron, natural basis, delivered at rail of vessel, lower lake ports)

Shipping Season	Date Price Established	Bessemer grade[1] Mesabi	Bessemer grade[1] Old range	Nonbessemer grade[2] Mesabi	Nonbessemer grade[2] Old range	High phosphorus[3]	Open hearth Lump
1946[5]	-	$ 5.20	$ 5.45	$ 5.05	$ 5.30	$ 5.05	n. a.
1947	Jan. 25, '47	5.70	5.95	5.55	5.80	5.55	n. a.
1948	Mar. 27, '48	6.35	6.60	6.20	6.45	6.20	n. a.
1949	Dec. 30, '48	7.35	7.60	7.20	7.45	7.20	n. a.
1950	Jan. 26, '50	7.85	8.10	7.70	7.95	7.70	n. a.
1951[6]	Dec. 2, '50	8.45	8.70	8.30	8.55	8.30	n. a.
	n. a.	8.45	8.70	8.30	8.55	8.30	n. a.
1952[6]	July 26, '52	9.20	9.45	9.05	9.30	9.05	n. a.
	Feb. 12, '53	9.85	10.10	9.70	9.95	9.70	$10.95
1953	July 1, '53	10.05	10.30	9.90	10.15	9.90	11.15
1954	Feb. 17, '54	10.05	10.30	9.90	10.15	9.90	11.15
1955	Feb. 28, '55	10.25	10.40	10.10	10.25	10.00	11.25
1956	Feb. 20, '56	11.00	11.25	10.85	11.10	10.85	12.10
1957	Jan. 30, '57	11.60	11.85	11.45	11.70	11.45	12.70
1958	Feb. 19, '58	11.60	11.85	11.45	11.70	11.45	12.70
1959	Mar. 20, '59	11.60	11.85	11.45	11.70	11.45	12.70
1960	Apr. 1, '60	11.60	11.85	11.45	11.70	11.45	12.70
1961	Jan. 15, '61	11.60	11.85	11.45	11.70	11.45	12.70
1962	Apr. 1, '62	10.80	11.05	10.65	10.90	10.65	13.25
1963	Jan. 1, '63	10.80	11.05	10.65	10.90	10.65	12.70-13.25
1964	Jan. 29, '64	10.70	10.95	10.55	10.80	10.65	10.60-13.15

1 Ore containing 0.045 percent or less phosphorus, on dried basis.
2 Ore containing more than 0.045 percent but not more then 0.180 percent phosphorus, on dried basis.
3 Ore containing more than 0.180 percent phosphorus, on dried basis.
4 Less 5% vessel freight refund for full year.
5 Maximum prices established by the Office of Price Administration.
6 Prices controlled by ceiling-price regulations of the Office of Price Administration from January 26th, 1951, to February 11th, 1953, inclusive.

Table 2

UNITED STATES STEEL INGOT PRODUCTION BY PROCESS 1955 - 1964
(millions of net tons)

Year	Open Hearth	Basic Oxygen	Electric	Bessemer	Total
1955	105.4	0.3	8.0	3.3	117.0
1956	102.9	0.5	8.6	3.2	115.2
1957	101.6	0.6	8.0	2.5	112.7
1958	75.9	1.3	6.7	1.4	85.3
1959	81.6	1.9	8.5	1.4	93.4
1960	86.4	3.3	8.4	1.2	99.3
1961	84.5	3.9	8.7	0.9	98.0
1962	82.9	5.6	9.0	0.8	98.3
1963	88.8	8.5	10.9	1.0	109.3
1964	98.1	15.4	12.5	0.9	126.9

Source: American Iron and Steel Institute

N.B.: Basic Oxygen steel first produced in the United States in 1955.

Table 3

CANADIAN STEEL INGOT CAPACITY
by process 1955 - 64
(net tons)

Year	Open Hearth	Basic Oxygen	Electric	Total
1955	4,163,200	-	719,800	4,883,000
1956	4,428,000	-	764,000	5,192,000
1957	4,294,000	525,000	685,000	5,504,000
1958	4,497,000	710,000	706,000	5,913,000
1959	4,497,000	1,110,000	706,000	6,313,000
1960	4,481,000	1,440,000	798,000	6,719,000
1961	4,477,000	1,770,000	1,021,000	7,268,400
1962	5,002,000	1,870,000	954,000	7,826,000
1963	5,002,000	1,870,000	954,000	7,826,000
1964	5,420,000	2,550,000	1,015,500	8,985,500

Source: Primary Iron and Steel. D.B.S. 41 - 401.

Table 4

SOME RECENT ESTIMATES OF FUTURE NORTH AMERICAN STEEL REQUIREMENTS

Author	Year	For Year	Est. requirements (1000 short tons)	Source
United States				
Paley etc.	1952	1975	147,000	President's Materials Policy Comm.
B.F. Fairless	1954	1974	155,130*	Skillings, October 15th, 1955.
G.M. White	1955	1975	170,000*	Eng. Min. J. December 1955.
J.L. Manthe	1955	1970	180,000*	Skillings, May 31st, 1958.
J.S. Block	1955	1980	216,000*	Eng. Min. J. December 1955.
A.B. Homer	1956	1971	200,000*	Inv. Bankers' Ass. address 27/11/56
T. Campbell	1956	1975	151,400	Iron Age. November 29th, 1956.
J.C.O. Harris	1957	1975	180,000	J. of Metals. December 1957.
H.C. Downer & Associates	1958	1970	122,000*	U.S. Maritime Administration Study
Anon	1958	1975	200,000*	Steel. September 15th, 1958.
Army Engineers	1958	1971	163,346	Iron Ore Traffic Report, 1958.
J.C.O. Harris	1960	1975	190,000	Min. Facts & Problems, 1960.
F.S. Smither & Co.	1960	1975	195,745	The Iron Ore Industry - Report 1960.
United Nations	1960	1972	147,500	Report on European Steel Industry.
H.S. Harrison	1960	1975	144,000	Eng. Min. J. July 1960.
H.E. Rollman	1961	1975	198,000	Northern Natural Gas Co.
Anon	1962	1972	162,600*	Financial World. May 23rd, 1962.
Inland Steel	1962	1970	150,000	Inland News. Spring 1962.
Landsberger etc.	1963	1970	141,000	Resources in America's Future.
Canada				
A.G. Wright	1956	1980	10,000	Statement to Gordon Commission
D.S. Holbrooke	1956	1975	11,000	Statement to Gordon Commission
H.G. Hilton	1956	1980	12,000	Statement to Gordon Commission
L. Morgan	1956	1980	12-14,000	Gordon Commission Report
P.E. Cavanagh	1958	1980	17,500	Blast Furnace Conf. 1958.
United Nations	1960	1972	12,000	Report on European Steel Industry
T.H. Janes	1962	1972	8-10,500	Department of Mines. MR46.
Anon	1962	1972	13,200*	Financial World. May 23rd, 1962.
W.D.G. Hunter	1964	1970	10-12,000	Business Q. Winter, 1964.
Burns Bros & Denton	1964	'69-'71	12,500	Report on Canadian Steel Industry.
Nesbitt, Thomson	1964	1980	14-16,000	Report on Canadian Steel Industry.
Qouted W. L. Dack	1965	1970	12,500	Financial Post. April 10th, 1965.

* Estimates of Steel capacity rather than production.

Table 5

SOME RECENT ESTIMATES OF FUTURE NORTH AMERICAN IRON ORE REQUIREMENTS

Author	Year	For Year	Est. requirements (1000 gross tons)	Source
United States				
Paley, etc.	1952	1975	200,000	President's Materials Policy Comm.
J.C.O. Harris	1957	1975	173,000	J. of Metals, December, 1957.
J.N. Mathieu	1958	1975	159,000	Annales des Mines. Jan. 1958.
Anon	1958	1975	196,430	Steel. September 15th, 1958.
Army Engineers	1958	1971	170,370	Iron Ore Traffic Report, 1958.
H.D. Downer & Associates	1958	1970	137,000	U.S. Maritime Administration Study.
V.D. Johnson	1958	1975	185,000	Skillings. May 31st, 1958.
A.S. Lundberg	1960	1972	93,200*	Blad. Berg. Vanner. Jan. 1960.
J.C.O. Harris	1960	1975	174,000	Min. Facts & Problems. 1960.
H.T. Reno	1960	1975	150,000	Min. Facts & Problems. 1960.
F.S. Smithers & Co.	1960	1975	204,652	The Iron Ore Industry - Report, 1960.
H.S. Harrison	1960	1975	180,000	Eng. Min. J. July, 1960.
H.E. Rollman	1961	1975	203,000	Northern Natural Gas Co.
Minn Task Force	1962	1975	134,000	Natural Resources of Minn. 1962.
P.D. Block	1962	1970	150,000	Quoted in Natural Res. of Minn. 1962.
Landsberger etc.	1963	1970	151,400	Resources in America's Future.
W.R.G. Hunter	1964	2000	300,000	Business Quarterly. Winter 1964.
Canada				
J. Davis	1956	1980	15,000	Gordon Commission Report.
P.E. Cavanagh	1958	1980	12,000	Blast Furnace etc. Conference 1958.
R.E. Caves & R.H. Holton	1959	1970	12,700	The Canadian Economy: Prospect and Retrospect.

* Total North America iron content only.

Table 6

RESOURCES FOR THE FUTURE - U.S. IRON AND STEEL STUDY
Summary of past and projected requirements
(in millions of net tons)

Year	Net Domestic iron & steel Consumption	Shipments of Steel Mill Products	Shipments of Ferrous Castings	Steel Ingot Production	Total Input of Ferrous Metallics	Consumption of Ferrous Scrap	Consumption of Pig Iron	Requirements of iron in ore (iron content)	Iron Ore Gross Requirements
1930	n. a.	33.8	n. a.	44.4	63.5	27.8	33.6	32.0	67.7
1940	n. a.	47.0	n. a.	66.6	92.2	42.4	46.2	43.6	83.8
1950	74.2	73.0	16.2	96.5	133.3	63.0	64.9	62.5	117.4
1951	83.1	80.1	18.1	104.8	148.6	70.8	71.4	71.1	135.6
1952	69.9	69.0	15.7	92.8	131.1	63.6	61.6	60.6	115.7
1953	80.3	80.2	16.5	111.3	152.8	70.9	74.7	73.3	138.6
1954	63.6	63.2	13.5	88.1	121.0	56.6	58.7	58.8	100.2
1955	83.6	84.7	17.5	116.8	160.2	75.3	77.2	77.1	135.1
1956	82.7	83.2	16.7	114.9	157.4	74.6	75.0	74.3	137.0
1957	77.7	79.9	15.3	112.4	152.9	68.2	76.4	79.2	148.0
1958	60.4	59.9	12.2	85.1	116.2	52.6	57.3	58.4	102.4
1959	73.6	69.4	14.6	93.3	130.1	61.8	61.8	60.7	103.1
1960	72.3	71.1	13.8	99.1	135.4	62.1	66.6	66.5	131.1
	Projected	Projected	Projected	Projected	Projected	Projected	Projected	Projected	Projected
1970	99	101	16.7	141	188	88.4	88	89.9	169.6
1980	121	126	18.7	176	231	108.6	107	110.9	209.2
1990	151	161	21.4	225	290	136.3	134	139.6	263.4
2000	194	210	25.3	294	375	176.2	171	180.6	340.7

Table 6 Continued

Key to Column Headings

1. Net Domestic Iron and Steel Consumption - Shipments of Steel mill products and Ferrous Castings (i. e. Sum of next two columns) less prompt industrial scrap plus net exports.

2. Steel Mill Products - Total shipments of blooms, billets, slabs, etc. from steel mills. Source: AISI Projections: Steel requirements of eight major end use categories plus future exports and prompt industrial scrap.

3. Shipments of Ferrous Castings - Total shipments from Iron Foundries. Source: Bureau of the Census. Projections: Iron castings requirements of eight major end use categories plus future exports and prompt industrial scrap.

4. Steel Ingot Production - Source: AISI (Equivalent to Steel Mill production plus home scrap generated in Steel Furnaces). Projection: Based on 140% of shipments of Steel Mill Products (Column 2).

5. Total Input of Ferrous Metallics - Steel Mill Consumption of Pig Iron, Scrap, Iron Ore and Ferroalloys. Source: Minerals Yearbook. Projection: Based on 110% of gross output of iron and steel (i. e. Shipments of steel mill products and ferrous castings plus total home scrap generated.)

6. Consumption of Ferrous scrap. Source: Minerals Yearbook. Projection: Based on 47% of total input of Ferrous Metallics.

7. Consumption of Pig Iron. Source: Minerals Yearbook. Projection: Based on Residual after deducting scrap, direct ore and ferroalloys from total input of ferrous metallics.

8. Requirements of Iron in Ore (Iron Content) - Source: Minerals Yearbook - Represents total domestic consumption adjusted for stock changes and manganiferous ores deflated by percentage iron content of ore consumed. Projection: Based on expected requirements of Blast and Steel Furnaces and Miscellaneous.

9. Iron Ore - Gross Requirements - Represents Requirements of Iron in ore divided by average iron content of ore consumed. (Projections: Based on iron content of 53%).

Table 7

DEVELOPMENT OF PIG IRON AND SCRAP CONSUMPTION IN U.S. STEEL FURNACES 1950 - 63
(Gross tons)

Year	Pig Iron Consumption	Scrap Consumption	Ratio	
			Pig Iron	Scrap
1950	56,269,610	51,091,581	52.4	47.6
1951	61,750,383	57,087,329	52.0	48.0
1952	53,491,734	52,217,060	50.6	49.4
1953	65,839,018	59,100,900	52.7	47.3
1954	51,658,482	46,064,651	52.9	47.1
1955	67,957,207	61,774,897	52.4	47.6
1956	66,437,573	62,276,019	51.6	48.4
1957	68,767,530	56,764,655	54.8	45.2
1958	51,299,102	43,023,625	54.4	45.6
1959	54,698,928	49,793,577	52.3	47.7
1960	60,092,000	51,140,000	54.0	46.0
1961	59,418,000	49,455,000	54.6	45.4
1962	60,561,000	49,606,000	55.0	45.0
1963	66,188,000	56,506,000	53.9	46.1

Source: Minerals Yearbook.

Table 8

RATIOS, UNITED STATES IRON ORE CONSUMPTION TO PIG IRON AND STEEL PRODUCTION
1943 - 1964

Year	Iron Ore Consumption (thousands of gross tons) (a)	Average Iron Content%*	Pig Iron Production (thousands of net tons) (b)	Steel Ingot Production (thousands of net tons) (c)	Ratio a/b	Ratio a/c	Ratio b/c
1943	100,457	51	60,765	88,837	1.653	1.131	.684
1944	99,942	51	61,004	89,642	1.638	1.115	.681
1945	86,158	51	53,224	79,702	1.619	1.081	.668
1946	72,175	51	44,842	66,603	1.610	1.084	.673
1947	96,116	51	58,327	84,894	1.648	1.132	.687
1948	100,499	50	60,073	86,640	1.673	1.160	.693
1949	89,218	51	53,323	77,978	1.673	1.144	.684
1950	106,610	50	64,500	96,836	1.653	1.101	.666
1951	114,837	52	70,278	105,200	1.634	1.092	.668
1952	100,641	51	61,308	93,168	1.642	1.080	.658
1953	122,125	51	74,853	111,610	1.632	1.094	.671
1954	94,229	53	57,948	88,312	1.626	1.067	.656
1955	125,028	53	76,849	117,036	1.627	1.068	.657
1956	125,171	53	75,030	115,216	1.668	1.086	.651
1957	129,375	54	78,404	112,715	1.650	1.148	.696
1958	91,900	55	57,155	85,255	1.608	1.078	.670
1959	93,662	56	60,210	93,446	1.556	1.002	.644
1960	108,050	56	66,501	99,282	1.625	1.088	.670
1961	99,254	56	64,853	98,014	1.530	1.013	.662
1962	99,562	56	65,638	98,328	1.517	1.013	.668
1963	112,535	58	71,840	109,261	1.566	1.030	.658
1964	n.a.	n.a.	86,212	126,898	-	-	.679

* Calculated as weighted average of the iron content of ore produced in the U.S. and of ore imported for consumption.

Source: Minerals Yearbook.

Table 9

FERROUS METALS IN CANADA
1949 - 1963
(thousands of tons)

Year	Production of Steel Ingots (net tons)	Production of Iron Castings (net tons)	Production of Pig Iron (net tons)	Consumption of Ferrous Scrap (net tons)	Consumption of Iron Ore (Gross tons)
1949	3190	778	2154	2476	3247
1950	3384	779	2317	2718	3972
1951	3569	907	2553	2918	4719
1952	3703	812	2682	2910	5083
1953	4116	771	3012	2984	5230
1954	3195	663	2211	2385	3812
1955	4535	849	3215	3285	5583
1956	5301	938	3568	3897	6386
1957	5068	790	3718	3561	5966
1958	4359	724	3060	2945	4697
1959	5901	856	4183	3843	5813
1960	5809	743	4278	3733	6814
1961	6488	702	4946	3888	7442
1962	7173	712	5289	4106	7387
1963	8190	773	5915	4732	8369
1964	8968	868	6541	5390	9279

Source: Dominion Bureau of Statistics.
Department of Mines and Technical Surveys.

Table 10

PRODUCTION OF IRON ORE IN THE UNITED STATES
1880 - 1963 * in gross tons

Year	Gross tons	Year	Gross tons	Year	Gross tons
1880	7,120,362	1908	35,983,336	1936	48,788,745
1881	7,119,643	1909	51,294,271	1937	72,093,548
1882	8,700,000	1910	57,014,906	1938	28,447,282
1883	8,800,000	1911	43,876,552	1939	51,731,730
1884	7,718,129	1912	55,150,147	1940	73,695,899
1885	7,600,000	1913	61,980,437	1941	92,409,579
1886	10,600,000	1914	41,439,761	1942	105,526,195
1887	11,300,000	1915	55,526,490	1943	101,247,835
1888	12,062,530	1916	75,167,672	1944	94,117,705
1889	14,518,041	1917	75,288,851	1945	88,376,393
1890	16,036,043	1918	69,658,278	1946	70,843,113
1891	14,591,178	1919	60,965,418	1947	93,091,520
1892	16,296,666	1920	67,604,465	1948	101,003,492
1893	11,587,629	1921	29,490,978	1949	84,937,447
1894	11,879,679	1922	47,128,527	1950	98,045,360
1895	15,957,614	1923	69,351,442	1951	116,504,672
1896	16,005,449	1924	54,267,419	1952	97,918,004
1897	17,518,046	1925	61,907,997	1953	117,994,769
1898	19,433,716	1926	67,623,000	1954	78,128,794
1899	24,683,173	1927	61,741,100	1955	103,002,744
1900	27,553,161	1928	62,197,088	1956	97,877,331
1901	28,887,479	1929	73,027,720	1957	106,148,419
1902	35,554,135	1930	58,408,664	1958	67,709,000
1903	35,019,308	1931	31,131,502	1959	60,276,000
1904	27,644,330	1932	9,846,916	1960	88,784,000
1905	42,526,133	1933	17,553,188	1961	71,329,000
1906	47,749,728	1934	24,587,616	1962	71,829,000
1907	51,720,619	1935	30,540,252	1963	73,599,000

Sources: Minerals Resources of the United States and Minerals Yearbooks.

* Includes by product ore after 1941.

Table 11

Consumption of iron ore in the United States, 1943 - 1963, by uses, in gross tons

Year	Metallurgical uses				Miscellaneous uses			Total
	Iron Blast Furnaces	Steel Furnaces	Agglomer-ating Plants	Ferro-alloy Furnaces	Cement	Paint	Other	
1943	85,255,923	4,126,086	10,362,946	528,496	7,363	26,124	150,151	100,456,989
1944	82,812,466	4,144,344	12,247,501	411,632	82,236	9,779	234,496	99,942,454
1945	71,318,003	3,408,955	10,835,840	400,309	79,677	9,642	106,069	86,158,495
1946	60,461,276	3,182,487	8,066,427	248,789	137,876	54,470	23,519	72,174,844
1947	78,863,953	4,111,676	12,529,497	328,578	166,579	103,006	12,260	96,115,549
1948	82,376,370	4,350,596	13,091,069	346,481	212,702	111,317	10,022	100,498,557
1949	72,965,217	3,803,948	11,869,127	238,739	207,718	80,026	53,723	89,218,498
1950	86,921,468	4,727,635	14,276,181	247,697	230,746	115,407	91,139	106,610,273
1951	91,648,808	5,485,659	16,795,596	424,860	248,604	112,885	120,700	114,837,112
1952	78,981,700	5,167,043	15,694,302	388,096	243,072	110,032	56,391	100,640,636
1953	93,802,204	6,819,171	20,727,210	367,533	223,561	90,287	94,695	122,124,661
1954	68,541,712	5,589,859	18,149,304	304,752	217,628	87,456	1,338,424	94,229,135
1955	94,811,483	7,114,418	22,365,368	300,374	256,301	102,949	77,413	125,028,306
1956	89,163,405	7,270,299	27,903,269	441,845	262,378	32,469	97,037	125,170,702
1957	87,423,926	7,525,231	33,762,555	264,592	258,160	25,882	114,888	129,375,234
1958	52,473,520	6,101,346	32,464,363	158,798	254,586	13,279	433,649	91,899,541
1959	49,036,315	6,185,714	37,263,042	318,137	329,388	19,036	510,041	93,661,673
1960	45,994,805	6,601,077	54,461,412	220,675	361,198	47,524	363,304	108,049,995
1961	39,766,705	6,419,896	52,602,264	n. a.	n. a.	n. a.	465,077	99,253,942
1962	37,420,771	5,931,102	58,363,399	n. a.	n. a.	n. a.	847,975	102,563,247
1963	60,939,287	6,667,107	35,850,416	n. a.	n. a.	n. a.	522,128	103,978,938

Source: Minerals Yearbook.
n. a. Not available - included in "other" column.

Table 12

TRENDS IN UNITED STATES PER CAPITA PIG IRON, IRON ORE, AND STEEL PRODUCTION, 5 YEAR AVERAGES, 1880 - 1964

Year	Iron Ore Production		Pig Iron Production		Steel Production		Population	Iron ore per capita gross ton	pig iron per capita net ton	Steel per capita net ton
	Gross tons	Net tons	Gross tons	Net tons	Gross tons	Net tons				
1880-84	7,891,627	8,814,430	4,259,229	4,770,337	1,559,351	1,746,473	52,799,448	.15	.09	.03
1885-89	11,096,114	12,427,648	6,047,677	6,701,398	2,779,733	3,113,301	59,216,734	.19	.11	.05
1890-94	14,078,239	15,767,627	8,104,293	9,054,408	4,308,184	4,825,166	65,644,065	.21	.14	.07
1895-99	18,719,600	20,965,932	10,623,350	11,898,152	7,625,239	8,540,268	72,189,240	.26	.16	.11
1900-04	30,931,683	34,643,484	16,399,038	18,366,922	13,400,808	15,008,905	79,107,405	.39	.23	.19
1905-09	45,854,817	51,357,395	23,162,484	25,941,982	20,952,589	23,466,900	87,091,399	.53	.30	.27
1910-14	51,892,361	58,119,044	26,995,689	30,235,172	27,167,246	30,427,316	95,503,152	.54	.32	.32
1915-19	67,321,342	75,399,903	35,608,447	39,881,460	39,823,797	44,602,653	102,699,164	.66	.39	.43
1920-24	53,568,566	59,996,794	30,920,191	34,182,613	36,079,058	40,408,546	110,074,059	.49	.21	.37
1925-29	65,299,381	73,135,307	38,681,727	43,523,535	49,320,025	55,238,428	118,908,061	.55	.37	.46
1930-34	28,305,577	31,702,247	17,393,643	19,480,880	25,832,756	29,033,687	124,721,540	.23	.16	.23
1935-39	46,306,989	51,863,827	27,376,909	30,654,019	41,584,170	46,574,271	128,966,580	.36	.24	.36
1940-44	93,399,443	104,607,376	50,381,421	56,427,192	73,987,855	82,866,398	134,823,455	.69	.42	.61
1945-49	87,650,393	98,168,440	48,176,741	53,957,950	71,038,766	79,563,418	143,659,600	.61	.38	.55
1950-54	107,688,000	119,281,000	60,908,000	65,777,000	91,644,000	99,025,000	157,522,000	.68	.42	.63
1955-59	113,027,000	126,590,000	62,080,000	69,530,000	93,513,000	104,734,000	171,906,000	.66	.40	.61
1960-64*	110,882,000	124,188,000	63,401,000	71,009,000	94,962,000	106,357,000	186,549,000	.59	.38	.57

* Partly estimated.

Source: Minerals Yearbook.

Table 13

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
GREAT LAKES AREA 1960

Port of Destination	Total Receipts	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie							
Detroit	8,143,784	6,148,278	1,186,306	-	238,235	518,786	52,179
Toledo	4,139,919	3,880,749	129,116	-	130.054	-	-
Huron	1,319,768	1,020,137	235,432	-	54,511	9,688	-
Lorain	4,298,768	4,185,189	46,825	-	66,754	-	-
Cleveland	13,240,570	11,673,824	532,400	-	934,886	99,460	-
Ashtabula	6,988,472	5,310,645	146,929	-	1,524,328	6,570	-
Conneault	5,784,824	5,724,071	1,639	-	-	59,114	-
Erie	304,483	304,483	-	-	-	-	-
Buffalo	6,258,385	5,558,725	206,230	196,237	143,935	153,258	-
Sub Total	50,478,973	43,806,101	2,484,877	196,237	3,092,703	846,376	52,179
U.S. Lake Michigan							
Indiana Harbor	7,494,631	6,225,688	1,268,943	-	-	-	-
Gary*	9,695,152	9,695,152	-	-	-	-	-
Chicago	8,003,381	7,861,760	87,511	-	14,214	39,986	-
Sub Total	25,193,164	23,782,600	1,356,454	-	14,214	39,896	-
Canada							
Contrecoeur	441,859	-	-	-	98,061	-	343,798
Hamilton	3,883,938	3,614,374	-	-	238,346	31,218	-
Montreal	68,410	-	-	-	4,836	-	63,574
Port Colborne	134,085	105,285	28,800	-	-	-	-
Sault Ste. Marie	1,380,723	1,069,158	311,565	-	-	-	-
Sub Total	5,909,015	4,788,817	340,365	-	341,243	31,218	407,372
Total	81,581,152	72,377,518	4,181,696	196,237	3,448,160	917,990	459,551

* Total may include receipts from Canadian Great Lakes Ports.

Sources: Waterborne Commerce of the United States (Part 3); St. Lawrence Seaway Authority, Dominion Bureau of Statistics

Table 14

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION GREAT LAKES AREA 1961

Port of Destination	Total Receipts	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie								
Detroit	7,174,000	6,224,365	574,211	-	146,133	14,450	214,841	-
Toledo	3,895,133	3,383,994	163,738	-	-	329,629	17,772	-
Huron	994,071	675,153	292,931	-	-	25,987(2)	-	-
Lorain	3,706,717	3,634,960	25,812	45,945	-	-	-	-
Celveland	12,937,898	10,458,398	520,617	41,832	8,724	1,638,191	270,136	-
Ashtabula	4,749,380	4,122,697	87,172	16,510	-	499,560	23,441	-
Conneualt	705,658	705,658	-	-	-	-	-	-
Erie	230,982	226,903	-	-	-	-	4,079	-
Buffalo	5,564,357	4,807,679	556,242	13,119	-	156,788	30,529	-
Sub Total	39,958,196	34,239,807	2,220,723	117,406	154,857	2,664,605	560,798	-
U.S. Lake Mich								
Indiana Harbor	7,783,043	6,487,953	1,220,371	-	-	-	74,719	-
Gary*	7,670,365	7,670,365	-	-	-	-	-	-
Chicago	6,929,853	6,742,361	141,218	-	-	12,369	33,905	-
Sub Total	22,383,261	20,900,679	1,361,589	-	-	12,369	108,624	-
Canada								
Contrecoeur	526,639	171,081	-	-	-	-	-	355,558
Hamilton	3,527,510	2,860,814	-	386,081	-	229,514	51,101	-
Port Colborne	260,380	168,561	79,089	-	-	2,510*	10,220(1)	-
Sault Ste. Marie	1,644,009	1,408,250	227,063	-	-	-	8,696	-
Montreal	125,673	24,637	-	26,880	-	75	-	74,081
Sub Total	6,084,211	4,633,343	306,152	412,961	-	232,099	70,017	429,639
Overseas	15,824	144	-	15,680	-	-	-	-
Total	68,441,492	59,773,973	3,888,464	546,047	154,857	2,909,073	739,439	429,639

* Total may include receipts from Canadian Great Lakes Ports. (1) Thorold (2) Sandusky

Sources: Waterborne Commerce of the United States (Part 3); St. Lawrence Seaway Authority; Dominion Bureau of Statistics 54 - 207.

Table 15

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
GREAT LAKES AREA 1962

Port of Destination	Total Receipts	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie								
Detroit	8,518,922	6,698,566	763,842	-	207,788	721,910	117,714	9,102
Toledo	3,628,281	3,244,580	36,223	-	-	347,478	-	-
Huron	1,105,223	663,924	441,299	-	-	-	-	-
Lorain	3,665,469	3,506,286	2,461	-	112,151	-	44,571	-
Cleveland	11,962,032	9,215,492	450,893	-	-	2,176,415	119,232	-
Ashtabula	6,262,790	4,777,489	101,863	-	17,921	1,340,792	24,725	-
Conneault	1,793,324	1,793,324	-	-	-	-	-	-
Erie	271,902	271,902	-	-	-	-	-	-
Buffalo	5,416,266	4,379,374	319,844	453,689	-	197,115	66,244	-
Sub Total	42,624,209	34,550,937	2,116,425	453,689	337,860	4,783,710	372,486	9,102
U.S. Lake Michigan								
Indiana Harbor	7,993,766	6,213,227	1,590,142	-	-	-	190,397	-
Gary	7,299,101	7,299,101	-	-	-	-	-	-
Chicago	6,443,707	6,173,659	145,630	-	109,845	-	14,573	-
Sub Total	21,736,574	19,685,987	1,735,772	-	109,845	-	204,970	-
Canada								
Contrecoeur	567,697	15,126	-	-	-	7,840	-	544,731
Hamilton	4,060,111	3,870,266	118,164	-	-	71,681	-	-
Montreal	48,241	-	-	-	-	-	-	48,241
Port Colborne	222,513	141,943	65,372	-	-	-	15,198	-
Sault Ste. Marie	1,493,595	1,124,836	335,283	-	-	-	33,476	-
Sub Total	6,392,157	5,152,171	518,819	-	-	79,521	48,674	592,972
Overseas	60,881	60,881	-	-	-	-	-	-
Total	70,813,821	59,449,976	4,371,016	453,689	447,705	4,863,231	626,130	602,074

Total may include receipts from Canadian Great Lakes Ports.

Sources: Waterborne Commerce of the United States (Part 3); St. Lawrence Seaway Authority; Dominion Bureau of Statistics 54 - 207.

Table 16

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION GREAT LAKES 1963

Port of Destination	Total Receipts	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie								
Detroit	9,345,009	7,767,633	844,872	-	221,746	416,253	94,505	-
Toledo	4,687,480	4,226,869	74,105	-	-	386,506	-	-
Huron	1,253,938	875,314	378,624	-	-	-	-	-
Lorain	2,730,110	2,611,481	35,647	-	24,922	58,060	-	-
Cleveland	12,763,562	10,072,629	-	-	-	2,610,116	80,817	-
Ashtabula	6,423,390	5,129,753	456,319	-	-	817,070	20,248	-
Conneaut	1,684,524	544,315	-	-	1,123,657	-	16,552	-
Erie	256,353	256,353	-	-	-	-	-	-
Buffalo	6,122,485	4,723,808	236,537	431,429	-	679,631	51,080	-
Sub Total	45,266,851	36,208,155	2,026,104	431,429	1,370,325	4,967,636	263,202	-
U.S. Lake Michigan								
Indiana Harbor	8,707,319	6,597,401	1,942,771	-	-	-	167,147	-
Gary	8,264,308	8,264,308	-	-	-	-	-	-
Chicago	6,848,303	5,694,378	-	-	1,134,093	-	19,832	-
Sub Total	23,819,930	20,556,087	1,942,771*	-	1,134,093	-	186,979	-
Canada								
Contrecoeur	483,823	75,798	-	-	-	-	-	408,025
Hamilton	4,378,956	4,252,442	-	-	-	123,141	-	3,373
Port Colborne	271,314	192,492	78,822	-	-	-	-	-
Sault Ste Marie	1,599,791	1,177,052	422,739	-	-	-	-	-
Sept Iles	26,921	26,921	-	-	-	-	-	-
Sub Total	6,760,805	5,724,705	501,561	-	-	123,141	-	411,398
Total	75,847,586	62,488,947	4,470,436	431,429	2,504,418	5,090,777	450,181	411,398

* Total may include receipts from Canadian Great Lakes Ports.

Source: Waterborne Commerce of the United States (Part 3); St. Lawrence Seaway Authority; Dominion Bureau of Statistics 54 - 207.

Table 17

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
GREAT LAKES AREA 1964

Port of Destination	Total Receipts(p)	U.S. Great Lakes Ports(p)	Canadian Great Lakes Ports(p)	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas (p)
U.S. Lake Erie								
Detroit	10,716,790	7,846,773	1,056,026	-	383,073	1,388,555	42,363	-
Toledo	5,326,306	5,200,609	22,288	-	13,490	89,919	-	-
Huron	1,228,411	806,701	391,055(1)	-	-	30,655	-	-
Lorain	3,528,569	3,304,515	-	-	224,054	-	-	-
Celveland	15,650,253	12,336,440	455,898	-	178,049	2,532,413	147,453	-
Ashtabula	6,264,951	4,794,250	24,843	16,856	-	1,409,004	19,998	-
Conneaut	3,927,857	2,777,269	-	-	1,150,588	-	-	-
Erie	182,099	182,099	-	-	-	-	-	-
Buffalo	8,079,709	5,540,087	491,068	603,274	-	1,412,236	32,324	-
Sub Total	54,904,945	42,789,463	2,441,178	620,130	1,949,254	6,862,782	242,138	-
U.S. Lake Michigan								
Indiana Harbor	9,808,169	7,596,582	2,076,920	-	-	-	134,667	-
Gary	9,083,564	6,605,252	-	-	2,454,486	-	23,826	-
Chicago	7,004,792	6,519,671	30,639	-	418,921	-	35,561	-
Sub Total	25,896,525	20,721,505	2,107,559	-	2,873,407	-	194,054	-
Canada								
Contrecoeur	328,126	-	-	-	-	-	-	328,126
Hamilton	4,136,953	4,103,989	-	-	-	29,244	3,720	-
Port Colborne	459,359	288,171	171,188	-	-	-	-	-
Sault Ste. Marie	1,510,651	1,006,512	504,139	-	-	-	-	-
Sub Total	6,435,089	5,398,672	675,327	-	-	29,244	3,720	328,126
Total	87,236,559	68,909,640	5,224,064	620,130	4,822,661	6,892,026	439,912	328,126

(1) 20,927 tons to Sandusky.
P = Preliminary
Sources: Waterborne Commerce of the United States (Part 3); St. Lawrence Seaway Authority; Dominion Bureau of Statistics 54 - 207.

Table 18

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
IN PERCENTAGE TERMS - GREAT LAKES AREA 1960

Port of Destination	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie						
Detroit	75.5	14.6	-	2.9	6.4	0.6
Toledo	93.7	3.1	-	3.2	-	-
Huron	77.3	17.8	-	4.1	0.7	-
Lorain	97.3	1.1	-	1.6	-	-
Celveland	88.2	4.0	-	7.1	0.7	-
Ashtabula	76.0	2.1	-	21.8	0.1	-
Conneaut	98.9	0.1	-	-	1.0	-
Erie	100.0	-	-	-	-	-
Buffalo	88.8	3.3	3.1	2.3	2.4	-
Sub Total	86.8	4.9	0.4	6.1	1.7	0.1
U.S. Lake Michigan						
Indiana Harbor	83.1	16.9	-	-	-	-
Gary	100.0	-	-	-	-	-
Chicago	98.2	1.0	-	0.2	0.5	-
Sub Total	94.4	5.4	-	0.1	0.2	-
Canada						
Contrecoeur	-	-	-	22.2	-	77.8
Hamilton	93.0	-	-	6.1	0.8	-
Montreal	-	-	-	7.1	-	92.9
Port Colborne	78.5	21.5	-	-	-	-
Sault Ste. Marie	77.4	22.6	-	-	-	-
Sub Total	81.0	5.8	-	5.8	0.5	6.9
Total	88.7	5.1	0.2	4.2	1.1	0.6

Table 19

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
IN PERCENTAGE TERMS - GREAT LAKES AREA 1961

Port of Destination	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie							
Detroit	86.7	8.0	-	2.0	0.2	3.0	-
Toledo	87.0	4.2	-	-	8.5	0.4	-
Huron	67.9	29.5	-	-	2.6	-	-
Lorain	98.1	0.7	1.2	-	-	-	-
Celveland	80.8	4.0	0.3	0.1	12.7	2.1	-
Ashtabula	86.8	1.8	0.3	-	10.5	0.5	-
Conneault	100.0	-	-	-	-	-	-
Erie	98.3	-	-	-	-	1.7	-
Buffalo	86.4	10.0	0.2	-	2.8	0.5	-
Sub Total	85.7	5.6	0.3	0.4	6.7	1.4	-
U.S. Lake Michigan							
Indiana Harbor	83.4	15.7	-	-	-	1.0	-
Gary	100.0	-	-	-	-	-	-
Chicago	97.3	2.0	-	-	0.2	0.5	-
Sub Total	93.4	6.1	-	-	0.1	0.5	-
Canada							
Contrecoeur	32.5	-	-	-	-	-	67.5
Hamilton	81.1	-	10.9	-	6.5	1.4	-
Port Colborne	64.7	30.4	-	-	1.0	3.9	-
Sault Ste. Marie	85.6	13.8	-	-	-	0.5	-
Montreal	19.6	-	21.4	-	0.1	-	58.9
Sub Total	76.2	5.0	6.8	-	3.8	1.1	7.1
Overseas	0.9	-	99.1	-	-	-	-
Total	87.3	5.7	0.8	0.2	4.3	1.1	0.6

Table 20

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
IN PERCENTAGE TERMS - GREAT LAKES AREA 1962

Port of Destination	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie							
Detroit	78.6	9.0	-	2.4	8.5	1.4	0.1
Toledo	89.4	1.0	-	-	9.6	-	-
Huron	60.1	39.9	-	-	-	-	-
Lorain	95.7	0.1	-	3.1	-	1.2	-
Cleveland	77.0	3.8	-	-	18.2	1.0	-
Ashtabula	76.3	1.6	-	0.3	21.4	0.4	-
Conneault	100.0	-	-	-	-	-	-
Erie	100.0	-	-	-	-	-	-
Buffalo	80.8	5.9	8.4	-	3.6	1.2	-
Sub Total	81.0	5.0	1.1	0.8	11.2	0.9	0.1
U.S. Lake Michigan							
Indiana Harbor	77.7	19.9	-	-	-	2.4	-
Gary	100.0	-	-	-	-	-	-
Chicago	95.8	2.2	-	1.7	-	0.2	-
Sub Total	90.6	8.0	-	0.5	-	0.9	-
Canada							
Contrecoeur	2.7	-	-	-	1.4	-	95.9
Hamilton	95.3	2.9	-	-	1.8	-	-
Montreal	-	-	-	-	-	-	100.0
Port Colborne	63.8	29.4	-	-	-	6.8	-
Sault Ste. Maire	75.3	22.4	-	-	-	2.2	-
Sub Total	80.6	8.1	-	-	1.2	0.8	9.3
Overseas	100.0	-	-	-	-	-	-
Total	83.9	6.2	0.6	0.6	6.9	0.9	0.9

Table 21

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION IN PERCENTAGE TERMS - GREAT LAKES AREA 1963

Port of Destination	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie							
Detroit	83.1	9.0	-	2.4	4.5	1.0	-
Toledo	90.2	1.6	-	-	8.2	-	-
Huron	69.8	30.2	-	-	-	-	-
Lorain	95.6	1.3	-	0.9	2.1	-	-
Cleveland	78.9	-	-	-	20.4	0.6	-
Ashtabula	79.9	7.1	-	-	12.7	0.3	-
Conneault	32.3	-	-	66.7	-	1.0	-
Erie	100.0	-	-	-	-	-	-
Buffalo	77.2	3.9	7.0	-	11.1	0.8	-
Sub Total	80.0	4.5	1.0	3.0	11.0	0.5	-
U.S. Lake Michigan							
Indiana Harbor	75.8	22.3	-	-	-	1.9	-
Gary	100.0	-	-	-	-	-	-
Chicago	83.1	-	-	16.5	-	0.3	-
Sub Total	86.3	8.2	-	4.8	-	0.8	-
Canada							
Contrecoeur	15.7	-	-	-	-	-	84.3
Hamilton	97.0	-	-	-	2.8	-	0.2
Port Colborne	70.9	29.1	-	-	-	-	-
Sault Ste. Maire	73.6	26.4	-	-	-	-	-
Sept Iles	100.0	-	-	-	-	-	-
Sub Total	84.7	7.4	-	-	1.8	-	6.1
Total	82.4	5.9	0.6	3.3	6.7	0.6	0.5

Table 22

SHIPMENTS OF IRON ORE BY ORIGIN AND DESTINATION
IN PERCENTAGE TERMS - GREAT LAKES AREA 1964

Port of Destination	U.S. Great Lakes Ports	Canadian Great Lakes Ports	Picton	Port Cartier	Sept Iles	Other St. Lawrence Ports	Overseas
U.S. Lake Erie							
Detroit	73.2	9.9	-	3.6	13.0	0.4	-
Toledo	97.6	0.4	-	0.3	1.7	-	-
Huron	65.7	31.8	-	-	2.4	-	-
Lorain	93.6	-	-	6.4	-	-	-
Celveland	78.8	2.9	-	1.1	16.2	0.9	-
Ashtabula	76.5	0.4	0.3	-	22.5	0.3	-
Conneaut	70.7	-	-	29.3	-	-	-
Erie	100.0	-	-	-	-	-	-
Buffalo	68.6	6.1	7.5	-	17.5	0.4	-
Sub Total	77.9	4.4	1.1	3.6	12.5	0.4	-
U.S. Lake Michigan							
Indiana Harbor	77.5	21.2	-	-	-	1.4	-
Gary*	72.7	-	-	27.0	-	0.3	-
Chicago	93.1	0.4	-	6.0	-	0.5	-
Sub Total	80.0	8.1	-	11.1	-	0.7	-
Canada							
Contrecoeur	†	-	-	-	-	-	100.0
Hamilton	99.2	-	-	-	0.7	0.1	-
Port Colborne	62.7	37.3	-	-	-	-	-
Sault Ste. Marie	66.6	33.4	-	-	-	-	-
Sub Total	83.9	10.5	-	-	0.5	-	5.1
Total	79.0	6.0	0.7	5.5	7.9	0.5	0.4

Table 23

RECEIPTS OF IRON ORE VIA ST. LAWRENCE SEAWAY EXPRESSED AS A PERCENTAGE OF TOTAL RECEIPTS 1960-64

Port of Destination	1960	1961	1962	1963	1964
U.S. Lake Erie					
Detroit	9.9	5.2	12.4	7.9	17.0
Toledo	3.2	8.9	9.6	8.2	2.0
Huron	4.8	2.6	-	-	2.4
Lorain	1.6	1.2	4.3	3.0	6.4
Cleveland	7.8	15.2	19.2	21.0	18.3
Ashtabula	21.9	11.3	22.1	13.0	23.1
Conneaut	1.0	-	-	67.7	29.3
Erie	-	1.7	-	-	-
Buffalo	7.8	3.5	13.2	18.9	25.4
Sub Total	8.3	8.8	14.1	15.5	17.6
U.S. Lake Michigan					
Indiana Harbor	-	1.0	2.4	1.9	1.4
Gary	-	-	-	-	27.3
Chicago	0.7	0.7	1.9	16.8	6.5
Sub Total	0.3	0.6	1.4	5.6	11.8
Canada					
Contrecoeur	-	32.5	2.7	15.7	-
Hamilton					
1) via Welland	93.0	81.1	98.2	97.0	99.2
2) via St. Lawrence	6.9	7.9	1.8	3.0	0.8
Montreal	-	41.0	-	-	-
Port Colborne	-	4.9	6.8	-	-
Sault Ste. Marie	-	0.5	2.2	-	-
Overseas	-	100.0	100.0	-	-

Table 24

U.S. PIG IRON CAPACITY BY REGION
1948 - 1960

Location	1948	1954	1960
	(Thousands of short tons)		
Kentucky (Ashland)	738	802	1,058
Ohio (Youngstown area)	6,486	6,720	6,871
Ohio (Central and South)	2,238	4,154	4,674
Pennsylvania (Pittsburgh area)	10,339	10,474	11,463
Pennsylvania (Western area, excl. Pittsburgh)	6,156	7,040	7,836
W. Virginia (Weirton & Benwood)	1,474	2,246	2,646
Total Pittsburgh-Youngstown District	27,431	31,436	34,548
Illinois (Chicago & Granite City)	6,168	7,103	7,955
Indiana (E. Chicago, Gary)	7,951	8,687	10,324
Duluth, Minnesota	581	581	696
Total Chicago District	14,700	16,371	18,975
Michigan (Detroit area)	1,604	2,800	5,290
Ohio (Lake area)	4,891	5,915	7,090
Total Cleveland-Detroit District	6,495	8,715	12,380
Maryland (Sparrows Point)	3,252	4,116	5,480
Massachusetts	176	191	195
New York (Buffalo dis. & Troy)	4,335	5,328	5,947
Pennsylvania (Eastern)	3,488	5,692	7,032
Total Eastern District	11,251	15,327	18,654
Total Western District	2,612	3,879	4,724
Total Southern District	4,950	6,273	7,088
Grand Total All Districts	67,439	82,001	96,369

Source: American Iron and Steel Institute.

Table 25

ANALYSIS OF ORE SHIPPED FROM QUEBEC/LABRADOR REGION 1954 - 1964

(Gross tons)

Year	Bessemer (IOCC)	Non Bessemer (IOCC)	Magniferous (IOCC)	Concentrate Carol	Concentrate Q. C.	Pellets (Carol)
1954	-	1,460,601	320,851			
1955	996,579	5,802,128	922,987	-	-	-
1956	1,570,282	9,175,038	1,277,720	-	-	-
1957	1,291,545	9,621,483	1,522,631	-	-	-
1958	265,674	6,329,248	1,372,283	-	-	-
1959	757,976	10,918,019	1,382,911	-	-	-
1960	446,076	8,314,459	1,070,448	-	-	-
1961	244,366	6,673,709	525,512	-	1,239,572	-
1962	153,344	9,290,600	353,248	739,631	4,620,214	-
1963	200,630	6,402,769	149,827	2,216,974	6,585,958	1,834,602
1964	-	7,302,242	367,975	1,550,109	9,141,964	4,941,730

Source: Department of Mines and Technical Surveys.

Table 26

NORTH AMERICAN AGGLOMERATE CAPACITY
(as of January 1st, 1965)

PELLET PLANTS - OPERATING IN THE UNITED STATES

Company	Location	Annual Capacity Gross Tons
Bethlehem Steel Company		
Cornwall	Pennsylvania	700,000
Grace	Pennsylvania	1,500,000
The Cleveland-Cliffs Iron Co.		
Eagle Mills	Michigan	800,000
Empire [1]	Michigan	1,400,000
Humboldt	Michigan	800,000
Republic	Michigan	2,000,000
Erie Mining Company [2]	Minnesota	8,000,000
The Hanna Mining Co.		
Groveland	Michigan	1,250,000
Meramec Mining Company	Missouri	2,000,000
Reserve Mining Company	Minnesota	9,000,000
United States Steel Corporation		
Atlantic City Ore Operations	Wyoming	1,500,000
	UNITED STATES TOTAL	28,950,000

PELLET PLANTS - OPERATING IN CANADA

Company	Location	Annual Capacity Gross Tons
Bethlehem Steel Company		
Marmoraton	Ontario	450,000
Carol Pellet Company	Labrador	5,500,000
Hilton Mines Limited	Ontario	875,000

1 Planning to double capacity by 1967.
2 Expansion planned to raise to 10.3 million by 1967.

Company	Location	Annual Capacity Gross Tons
The International Nickel Co. of Canada, Limited	Ontario	750,000
Jones & Laughlin Steel Corp. Kirkland Lake	Ontario	1,250,000
Lowphos Ore, Limited	Ontario	625,000
Arnaud Pellets Pointe Noire	Quebec	4,900,000
	CANADA TOTAL	14,350,000

SINTER PLANTS*- OPERATING IN UNITED STATES

United States Steel Corporation	Minnesota	900,000
Jones & Laughlin Steel Corp.	New York	1,500,000
National Lead Company	New York	600,000
Republic Steel Corporation		
Chateaugay	New York	450,000
Port Henry	New York	700,000
Tennessee Copper Co. Div., Tennessee Corporation	Tennessee	500,000
Lone Star Steel Company	Texas	225,000
	UNITED STATES TOTAL	4,875,000

SINTER PLANTS* - OPERATING IN CANADA

Algoma Ore Properties Div. of The Algoma Steel Corp., Ltd.	Ontario	2,000,000
The Consolidated Mining & Smelting Co. of Canada Limited	British Columbia	268,000
	CANADA TOTAL	2,268,000

* List only includes Sinter Plants operating at or near mine site.

Source: Iron Ore Association

Table 27

NORTH AMERICA
PLANNED AGGLOMERATE CAPACITY

PELLET PLANTS - PLANNED IN THE UNITED STATES

Company	Location	Annual Capacity Gross Tons
The Cleveland - Cliffs Iron Co. (Mather)	Michigan	1,200,000
Eveleth Taconite Company	Minnesota	1,600,000
Hanna Mining Co.		
Itasca County	Minnesota	2,000,000
Pilot Knob	Missouri	750,000
Jones & Laughlin Steel Corp. Biwabick	Minnesota	1,500,000
Kaiser Steel Corporation Eagle Mountain	California	2,000,000
National Pellet Co.	Minnesota	2,400,000
United States Steel Corp.	Minnesota	4,500,000
Utah Construction Mining Co.	Nevada	1,000,000
	UNITED STATES TOTAL	16,950,000

PELLET PLANTS - PLANNED IN CANADA

Company	Location	Annual Capacity Gross Tons
Inland Steel Company Caland Ore	Ontario	1,000,000
Strathagani Mines Timagami	Ontario	1,000,000
	CANADA TOTAL	2,000,000

Table 28

GREAT LAKES ORE DISCHARGE FACILITIES

PORT	Entrance Channel Depth Ft.	Depth at Dock Ft.	Dock Length (ft.)	Operator	Ore Unloading Capacity S. T. per hour
So. Chicago, Ill. (Six Docks)	26' - 0" to Elgin, Joliet & East. R.R. Bridge 21' - 0" to Turning Basin No. 5	27' - 0"	2,530	U.S. Steel (North Dock)	2,000
		23' - 0"	1,100	U.S. Steel (South Dock)	1,400
		21' - 0"	"	Youngstown Sheet & Tube	2,500
		21' - 0"	1,457	Interlake Iron Corp.	2,370
		24' - 0"	2,235	Republic Steel Corp.	1,000
		22' - 0"	1,230	International Harvester Co. (Wisconsin Steel Works)	1,500
Indiana Harbor, Ind. (Three Docks)	27' - 0" (22' - 0" after 5 R.R. bridges)	27' - 0"	2,495	Youngstown Sheet & Tube	2,200
		27' - 0"	3,200	Inland Steel Co. No. 2	3,450
		22' - 0"	900	Inland Steel Co. No. 3	1,000
Gary Harbor, Ind. (One Dock)	27' - 0"	27' - 0"	4,740	U.S. Steel Corp.	3,350
Detroit, Mich. (Three Docks)	25' - 0" Downbound	22' - 0"	2,600	Ford Motor Company	2,350
	27' - 5" Upbound	26' - 0"	1,250	Great Lakes Steel No. 1 dock	1,000
		26' - 0"	950	Great Lakes Steel No. 3 dock	2,300
Trenton, Mich. (One Dock)	22' - 0"	27' - 0"	1,130	McLouth Steel Corp.	800
Toledo, Ohio (Three Docks)	25' - 0"	27' - 0"	1,200	Toledo Lakefront Dock Co.	2,500
		27' - 0"	1,100	Chesapeake & Ohio R.R.	1,700
		23' - 0"	1,675	Interlake Iron Corp.	400

Table 29 Great Lakes Ore Discharge Facilities

PORT	Entrance Channel Depth Ft.	Depth at Dock Ft.	Dock Length (ft)	Operator	Ore Unloading Capacity S. T. per hour
Huron, Ohio	25' - 0"	27' - 0"	1,400	Cleveland Stevedore Co.	1,700
Lorain, Ohio (Two Docks)	27' - 0"	26' - 0"	1,775	Toledo Lorain & Fairpost Co.	1,250
		25' - 0"	2,490	U.S. Steel, National Tube Div.	1,900
Cleveland, Ohio (Six Docks)	Main channel 29' - 0" Cuyahoga River 23' - 0"	23' - 0"	900	U.S. Steel	800
		23' - 0"	1,650	Jones & Laughlin Steel	900
		27' - 0"	1,875	Pennsylvania Railroad	3,500
		23' - 0"	1,044	Republic Steel (Lower Dock)	900
		23' - 0"	1,247	Republic Steel (Upper Dock)	1,000
		23' - 0"	1,600	Pickands Mather & Co.	2,400
Ashtabula, Ohio (Three Docks)	27' - 0"	26' - 0"	1,165	Ashtabula & Buffalo Dock Co.	2,500
		24' - 0"	1,200	Ohio & Western Penn. Dock Co.	2,400
		26' - 0"	1,200	Union Dock Co.	2,400
Conneaut, Ohio (One Dock)	30' - 0"	27' - 0"	1,560	Pittsburgh & Conneaut Dock Company	3,500
Erie, Pa. (One Dock)	28' - 0"	25' - 0"	1,230	Pickand Mather & Co.	1,450
Buffalo, N.Y. (Four Docks)	25' - 0" in outer harbor, 22'-0" in Buffalo River	21' - 0"	2,235	Hanna Furnace Corp.	400
		27' - 0"	3,950	Bethlehem Steel Corp.	2,200
		22' - 0"	1,190	Republic Steel Corp.	700
		21' - 0"	"	Ashtabula & Buffalo Dock Co.	600
Tonawanda, N.Y. (One Dock)	20' - 0"	22' - 0"	500	Tonawanda Iron Div. American Standard	350

Table 28 Great Lakes Ore Discharge Facilities

PORT	Entrance Channel Depth Ft.	Depth at Dock Ft.	Dock Length (ft)	Operator	Ore Unloading Capacity S. T. per hour
Hamilton, Ont. (Three Docks)	30' - 0"	24' - 0" 26' - 0" 26' - 0"	1,800 3,000 900	Steel Company of Canada Steel Company of Canada Dominion Foundries	1,000 1,700 2,100
Port Colborne (One Dock)	30' - 0"	27' - 0"	1,120	Algoma Steel Corp. Canadian Furnace Div.	300
Sault St. Marie (One Dock)	21' - 0"	24' - 0"	1,851	Algoma Steel Corp.	1,410

Sources: Greenwood's Guide to Great Lakes Shipping 1965.
Canadian Ports and Seaway Directory 1965.
Waterborne Commerce of the U.S. 1963.

Table 29

GREAT LAKES AND ST. LAWRENCE ORE LOADING FACILITIES

PORT	Entrance Channel Depth Ft.	Depth at Dock Ft.	Length at Dock Ft.	Storage (tons) Capacity	Operator
Two Harbors *, Minn. (Three Docks)	26' - 0"	28' - 0" 28' - 0" 28' - 0"	1,344 1,368 888	56,000 68,400 44,400	D. M. & I. R. Railway D. M. & I. R. Railway D. M. & I. R. Railway
Duluth, Minn. (Two Docks)	27' - 0"	28' - 0" 28' - 0"	2,304 2,304	115,200 153,600	D. M. & I. R. Railway D. M. & I. R. Railway
Superior, Wis. (Six Docks)	27' - 0"	27' - 0" 27' - 0" 25' - 0" 25' - 0" 25' - 0" 25' - 0"	2,244 2,100 1,812 612 600 648	130,900 122,500 90,600 35,700 35,000 37,800	Great Northern Railway Great Northern Railway Great Northern Railway Northern Pacific Railway Northern Pacific Railway Northern Pacific Railway
Ashland, Wis. (One Dock)	27' - 0"	27' - 0"	1,800	105,000	Soo Line Railway
Escanaba, Mich. (One Dock)	25' - 0"	30' - 0"	1,920	80,000	Chicago & North Western Railroad Company.
Marquette, Mich. (Two Docks)	25' - 0"	27' - 0" 25' - 0"	900 1,200	56,250 50,000	Soo Line Railway L. Superior & Ishpeming Rlwy.
Silver Bay, Minn. (One Dock)	30' - 0"	30' - 0"	2,485	5,450,000	Reserve Mining Company

Table 29 Great Lakes and St. Lawrence Ore Loading Facilities

PORT	Entrance Channel Depth Ft.	Depth at Dock Ft.	Length at Dock Ft.	Storage (tons) Capacity	Operator
Taconite Harbor, Minn. (One Dock)	27' - 0"	30' - 0"	1,200	100,000	Erie Mining Company.
Port Arthur, Ont. (One Dock + Ext.)	27' - 0"	25' - 0"	600 600	30,000 30,000	Canadian National Railway Canadian National Railway
Michipicoten, Ont. (One Dock)	21' - 0"	23' - 0"	1,270	23,500 (loading bin)	Algoma Central Railway
Depot Harbor, Ont. (One Dock)	30' - 0"	21' - 0"	800	300,000	Century Coal Co.
Little Current, Ont. (One Dock)	22' - 0"	27' - 0"	1,500	1,000,000	Canadian Pacific Railway
Picton, Ont. (One Dock)	27' - 0"	27' - 0"	765	63,000	Marmoraton Mining Company
Sept Iles, P.Q.	Deep water	37' - 0"	1,600	5,000,000	Iron Ore Company
Port Cartier, P.Q.	Deep water	50' - 0"	1,000	2,400,000	Quebec Cartier Mining Co.
Pointe Noire, P.Q.	Deep water	45' - 0"	1,600	5,078,000	Wabush Mines
Contrecoeur, P.Q. (Transfer Dock)	35' - 0"	35' - 0"	750	100,000	Iron Ore Company

* Docks inoperative in 1963 when tonnage transferred to Duluth.

Table 30

GREAT LAKES FLEET OF BULK FREIGHT
IRON ORE CARRYING VESSELS
1964 Season

UNITED STATES FLEET	No. of Vessels	Trip Capacity	% of Total Trip Capacity
Pittsburgh Fleet, U.S. Steel Corp.	48	681,400	27.0
Interlake Steamship Co.	24	342,600	13.6
Bethlehem Steel Co., Great Lakes Steamship Division	12	177,300	7.0
Wilson Marine Transit Co.	14	174,300	6.9
Hanna Mining Co., Agents	9	165,700	6.6
Oglebay Norton Co.	10	161,400	6.4
Cleveland-Cliffs Iron Co.	11	160,800	6.4
Inland Steel Co.	7	110.200	4.4
Republic Steel Corp.	9	107,700	4.3
Ford Motor Co.	5	74,300	2.9
Kinsman Marine Transit Co.	6	59,800	2.4
Tomlinson Fleet Corp.	5	56,900	2.3
Shenango Furnace Co.	3	54,400	2.2
Gartland Steamship Co.	6	54,100	2.1
Reiss Steamship Co.	5	52,000	2.1
International Harvester Co.	2	24,000	.9
Boland & Cornelius	2	21,000	.8
Buckeye Steamship Co.	2	19,500	.7
Brown Steamship Co.	2	14,800	.6
Browning Lines, Inc.	1	10,600	.4
	183	2,522,800	100.0%
CANADIAN FLEET			
Canada Steamship Lines, Ltd.	17	304,700	22.1
Scott Misener Steamship Ltd. and Subsidiary	12	240,600	17.5
Upper Lakes Shipping, Ltd.	13	217,900	15.8
N.M. Paterson & Sons Ltd.	13	137,600	10.0
Eastern Lake Carriers, Ltd. (Papachristidis)	4	100,000	7.3
Algoma Central Steamship Line	6	65,400	4.7
Reoch Steamship Co. Ltd. & Affiliates	6	62,100	4.5
Mohawk Navigation Co. Ltd.	4	58,700	4.3
Hall Corp. of Canada Ltd.	2	50,000	3.6
Carryore, Ltd.	2	48,000	3.5
Hindman Transp. Co. Ltd.	4	38,900	2.8
Quebec & Ontario Transp. Co. Ltd.	3	27,300	2.0
Nipigon Transport, Ltd.	1	27,000	1.9
	87	1,378,200	100.0%

Table 31

RECEIPTS OF IRON ORE AT GREAT LAKES
PORTS 1951 - 1963
(millions of net tons)

Port	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Lake Erie														
Detroit	3.6	3.7	4.3	3.6	5.7	5.3	6.2	5.2	4.5	8.2	7.3	8.5	9.3	10.7
Toledo	3.6	3.2	4.2	3.3	4.9	4.9	4.6	3.1	3.6	4.1	3.4	3.6	4.7	5.3
Huron	2.4	2.1	2.3	1.3	1.7	1.9	1.4	1.0	0.6	1.3	1.0	1.1	1.3	1.2
Lorain	8.3	6.2	8.1	4.4	4.7	4.5	4.9	2.3	2.2	4.3	3.7	3.7	2.7	3.5
Cleveland	15.3	13.3	18.2	10.7	15.1	11.4	14.1	8.3	6.4	13.3	12.9	12.0	12.7	15.7
Ashtabula	10.6	9.8	11.5	5.0	8.4	7.8	8.3	5.6	3.4	7.1	5.3	6.3	6.4	6.3
Conneaut	12.3	10.6	14.9	9.0	13.8	9.6	14.2	5.2	3.9	5.8	0.7	1.8	1.7	3.9
Erie	4.4	3.1	4.4	1.8	3.4	2.6	2.5	1.5	0.5	0.4	0.3	0.3	0.2	0.2
Buffalo	7.8	6.3	7.6	5.0	7.3	6.0	8.5	4.7	4.1	6.3	4.9	5.4	6.1	8.1
Total	68.3	58.3	75.5	44.1	65.0	54.0	64.7	36.9	29.2	50.8	39.5	42.7	45.1	54.9
Lake Michigan														
Ind. Harbor	7.6	6.3	7.6	6.3	8.1	6.6	8.2	6.8	4.8	7.6	8.0	8.2	8.7	9.8
Gary	7.4	5.5	7.3	6.4	8.3	7.0	8.5	6.9	5.1	9.6	7.7	7.3	8.3	9.1
S. Chicago	3.9	3.3	3.9	7.5	11.0	10.7	10.5	6.2	6.7	8.8	7.4	6.9	6.6	7.0
Total	18.9	15.1	18.8	20.2	27.4	24.3	27.2	19.9	16.6	26.0	23.1	22.4	23.6	25.9
Canada														
Sault S. Marie	1.8	1.7	1.3	0.9	1.5	2.0	1.6	1.2	1.3	1.5	1.6	1.5	1.2	1.5
Port Colborne	0.4	0.4	0.2	0.1	0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.5
Hamilton	1.8	2.2	3.0	2.2	2.8	3.2	3.3	2.6	3.0	3.8	3.6	4.0	4.2	4.1
Total	4.0	4.3	4.5	3.2	4.6	5.5	5.1	3.9	4.5	5.5	5.4	5.7	5.6	6.1
Grand Total	91.2	77.7	98.8	67.5	97.0	83.8	97.0	60.7	50.3	82.3	68.0	70.8	74.3	86.9

Sources: 1951 - 1962. Lake Carriers' Association, (converted to net tons).
U.S. 1963-64. U.S. Army Engineers.
Canada 1963-64. Dominion Bureau of Statistics.

N.B. South Chicago figures incomplete for years 1951 - 1953 inclusive.

Table 32

SHIPMENTS OF IRON ORE FROM GREAT LAKES PORTS 1951 - 1963
(millions of net tons)

Port	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Escanaba	7.3	6.2	6.9	4.4	6.7	5.8	6.6	3.7	3.4	7.4	5.7	5.3	5.7
Marquette	5.3	4.6	5.7	3.9	6.3	5.4	5.2	3.8	3.5	5.0	4.4	4.7	6.4
Ashland	3.1	3.1	3.7	4.1	4.6	3.9	3.9	2.5	1.5	1.2	1.2	1.2	0.7
Superior	35.4	31.9	39.3	24.8	38.1	32.6	30.7	17.7	13.8	20.7	17.5	16.7	17.2
Duluth	24.2	18.5	25.7	14.3	19.5	14.3	19.5	8.7	8.3	12.2	4.7	4.2	14.9
Two Harbors	22.1	17.5	23.7	14.4	19.2	16.1	19.2	11.8	9.1	15.4	12.1	13.2	-
Michipicoten	0.9	0.8	0.9	0.9	1.2	1.0	1.2	1.2	1.2	0.8	0.8	0.6	0.3
Port Arthur	1.5	1.4	1.5	1.3	2.5	3.7	2.6	1.3	3.3	2.6	2.5	3.5	3.3
Silver Bay	-	-	-	-	-	4.0	5.7	5.6	4.1	5.5	6.7	6.2	8.6
Taconite Har.	-	-	-	-	-	-	0.1	3.0	4.0	6.3	8.3	8.6	9.1
Little Current	-	-	-	-	-	-	-	0.1	0.1	0.1	0.2	0.2	0.4
Depot Harbor	-	-	-	-	-	-	-	-	0.2	0.6	0.6	0.4	0.5
Total	99.8	84.0	107.4	68.1	98.1	86.8	94.7	59.4	52.5	77.7	64.7	64.8	67.1

Source: Lake Carriers' Association (converted to net tons).

Table 33

IRON ORE IMPORTS TO UNITED STATES BY COUNTRY OF ORIGIN 1954-1963
(thousands of gross tons)

COUNTRY	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Algeria	29	20	11	-	-	-	-	-	-	-
Angola	-	-	-	-	-	17	-	-	-	-
Brazil	596	1,011	1,223	1,431	832	1,200	1,461	889	1,319	781
British West Africa	251	138	162	170	49	62	46	-	-	-
Canada	3,537	10,077	13,723	12,537	8,295	13,453	10,603	9,687	16,848	18,987
Chile	1,664	1,035	1,564	2,741	3,257	3,577	3,942	2,604	3,400	2,697
Cuba	32	43	93	33	-	4	3	-	-	-
Denmark	-	-	-	-	-	1	1	1	1	-
Dominican Republic	89	101	163	149	21	50	-	-	-	-
French West Africa	-	-	-	-	-	-	6	-	-	-
Germany, West	-	-	-	-	-	-	-	-	-	-
India	-	-	-	-	-	-	-	-	-	-
Iran	3	-	4	-	2	3	2	-	-	-
Italy	-	-	-	-	-	3	-	-	-	-
Japan	-	-	-	-	-	-	-	-	-	-
Liberia	764	928	1,218	1,013	838	1,090	907	715	756	1,311
Mexico	141	176	133	236	221	106	150	123	145	1
Norway	-	-	-	-	-	15	-	-	-	-
Panama	-	-	-	-	14	-	-	-	-	-
Peru	1,932	1,559	1,840	2,359	1,966	2,271	2,762	1,209	571	289
Philippines	-	-	24	-	54	71	1	-	49	22
Portuguese Asia	-	-	-	-	-	-	57	-	-	-
South Africa	-	-	-	14	-	-	-	23	-	21
Spain	-	-	-	-	-	-	-	-	-	-
Surinam	-	-	-	-	-	2	-	-	-	-
Sweden	1,544	1,221	999	677	113	136	94	78	32	36
United Kingdom	-	2	1	-	1	19	-	2	-	-
Venezuela	5,210	7,160	9,254	12,293	12,170	13,543	14,556	10,480	10,313	9,327
Yugoslavia	-	-	-	-	-	-	-	-	-	-
TOTAL	15,792	23,472	30,411	33,653	27,833	35,623	34,591	25,811	33,435	33,473

Source: Iron Ore Association

Table 34

UNITED STATES SEABOARD AND LAKE IMPORTS OF IRON ORE
1955 - 1962

Year	U.S. Imports Total	U.S. Seaboard Ports	Imports through U.S. Great Lakes by trade area			
			Canada Great Lakes	Canada Atlantic	Other	Total
1955	26,203,516	21,012,293	3,851,576	1,339,647	-	5,191,223
1956	33,387,720	26,398,485	4,812,274	2,176,961	-	6,989,235
1957	37,571,871	31,430,694	4,061,421	2,079,756	-	6,141,177
1958	30,435,165	26,246,027	2,817,579	1,371,559	-	4,189,138
1959	39,457,960	29,837,599	4,544,200	5,076,161	-	9,620,361
1960	37,770,000	29,636,831	4,260,419	3,849,148	23,602	8,133,169
1961	28,436,322	21,079,590	7,338,725*		18,007	7,356,732
1962	36,980,283	26,786,804	4,518,689	5,674,790	-	10,193,479

* Includes Atlantic Canada

Source: United States Waterborne Foreign Commerce Great Lakes Area.

Table 35

UNITED STATES IRON ORE PRODUCTION, 1942 - 1963, SHOWING INCREASE IN ORE BENEFICIATION

Year	Production Gross Tons		Usable ore Avg. % Fe	Direct shipping ore gross tons	% Direct ore of Usable	Crude ore treated, gross tons	Concentrates Gross tons	% Concentrates of Usable	Concentration ratio
	Crude	Usable							
1942	126,527,159	105,526,195	51.08	81,742,150	77.5	44,785,009	23,784,045	22.5	1.88
1943	119,674,980	101,247,835	51.08	79,833,785	78.8	39,841,195	21,414,050	21.2	1.86
1944	111,020,145	94,117,705	51.29	73,260,136	77.8	37,760,009	20,857,569	22.2	1.81
1945	106,312,399	88,376,393	51.41	67,768,993	76.7	38,543,406	20,607,400	23.3	1.87
1946	84,194,481	70,843,113	50.70	54,014,466	76.2	30,180,015	16,828,647	23.8	1.79
1947	113,972,214	93,091,520	50.44	71,121,676	76.4	42,850,538	21,969,844	23.6	1.95
1948	126,225,172	101,003,492	49.59	76,882,338	76.1	49,342,834	24,121,154	23.9	2.05
1949	104,850,736	84,937,447	50.16	63,970,016	75.3	40,880,720	20,967,431	24.7	1.95
1950	125,739,478	98,045,360	49.49	70,309,322	71.7	55,430,156	27,736,038	28.3	2.00
1951	152,113,723	116,504,672	50.79	85,281,923	73.2	66,831,800	31,222,749	26.8	2.14
1952	128,389,640	97,918,004	50.27	70,358,493	71.9	58,031,147	27,559,511	28.1	2.11
1953	156,612,319	117,994,769	50.44	82,163,882	69.6	74,448,437	35,830,887	30.4	2.08
1954	108,963,908	78,128,794	50.90	49,105,976	62.9	59,842,394	29,022,818	37.1	2.06
1955	142,328,187	103,002,744	51.25	66,746,189	64.8	75,183,329	36,252,780	35.2	2.07
1956	146,097,575	97,877,331	51.47	59,897,046	61.2	87,025,113	37,951,890	38.8	2.29
1957	160,825,294	106,148,419	51.39	63,885,256	60.2	110,523,081	42,263,163	39.8	2.62
1958	110,642,000	67,947,000	52.95	36,229,000	53.3	73,366,000	31,968,000	46.7	2.29
1959	103,430,000	60,276,000	53.06	29,975,000	49.7	72,608,000	30,363,000	50.3	2.39
1960	156,120,000	88,784,000	53.43	38,968,000	43.9	117,402,000	46,012,000	56.1	2.55
1961	137,433,000	71,329,000	54.37	25,924,000	36.3	110,824,000	46,125,000	63.7	2.40
1962	143,921,000	71,829,000	54.77	22,132,000	30.8	120,571,000	46,942,000	69.2	2.57
1963	152,776,000	73,599,000	56.25	15,218,000	20.7	138,297,000	57,277,000	79.3	2.41

Source: Minerals Yearbook.

Table 36

IRON ORE PRODUCTION, MESABI RANGE, LAKE SUPERIOR DISTRICT AND UNITED STATES
1900 - 1963 IN GROSS TONS

(Exclusive after 1905 of ore containing 5% or more manganese)

Year	Mesabi Range	Percent of Lake Superior District	Percent of United States	Lake Superior District*	Percent of United States	Total United States
1900-09(avg)	17,223,694	57.7	44.9	29,845,881	77.7	38,393,250
1910-19(avg)	32,806,922	65.5	55.0	50,049,841	84.0	59,606,851
1920-29(avg)	33,429,712	66.4	56.2	50,308,405	84.6	59,433,974
1930-39(avg)	21,451,499	69.0	57.5	31,083,566	83.3	37,312,944
1940-49(avg)	58,321,786	77.0	64.7	75,715,097	84.1	90,077,768
1950	60,838,025	76.7	62.4	79,291,824	81.3	97,470,391
1951	73,574,908	78.7	63.5	93,494,585	80.6	115,936,041
1952	59,370,538	77.5	61.0	76,618,520	78.7	97,313,863
1953	75,324,236	79.0	64.2	95,437,345	81.3	117,377,321
1954	45,724,827	75.2	58.5	60,836,246	77.9	78,128,794
1955	64,860,493	78.2	63.0	82,984,730	80.6	103,002,744
1956	59,346,091	76.6	60.6	77,467,545	79.1	97,877,331
1957	65,886,086	78.9	62.1	83,531,001	78.7	106,148,419
1958	40,860,000	78.9	60.3	51,777,000	76.5	67,709,000
1959	34,556,000	78.6	57.3	43,950,000	72.9	60,276,000
1960	54,442,000	75.8	61.3	71,792,000	80.9	88,784,000
1961	41,199,000	77.4	57.8	53,207,000	74.6	71,329,000
1962	43,041,000	77.5	59.9	55,556,000	77.3	71,829,000
1963	43,570,000	77.6	59.2	56,132,000	76.3	73,599,000

* Includes production from the 6 ranges of the true Lake Superior district.

Source: Minerals Yearbook.

Table 37

ESTIMATED POTENTIAL FOR MINNESOTA TACONITE PLANTS

	Location on Range	Type of Plant	Operating Company	Mining Length Miles	Estimated Potential Millions of Tons of Annual Pellet Capacity
1.	Dunka River	Magnetic	Erie Mining-(using Hoyt Lakes Plant)	2 - 3	3
2.	Babbitt	Magnetic	Reserve Mining	9 - 10	20
3.	Aurora-Hoyt Lakes	Magnetic	Erie Mining	9 - 10	17
4.	Biwabik	Magnetic	Jones & Laughlin	2 - 3	3
5.	Gilbert	Magnetic	Pickands Mather & others	2 - 3	3
6.	Eveleth	Magnetic	Eveleth Taconite (Ford & Oglebay-Norton)	2	3
7.	Virginia - Mountain Iron	Magnetic	U.S. Steel Corp.	6 - 7	20
8.	Buhl	Magnetic	Pickands Mather & U.S. Steel Corp.	4 - 5	3
9.	Chisholm-Hibbing	Magnetic, Non-magnetic, Semi-taconite	Various	4 - 5	3
10.	Keewatin-Nashwauk	Magnetic & Semi-taconite	Hanna Mining	8 - 10	9
11.	Calumet	Semi-taconite nag. &n.mag.	Cleveland Cliffs Jones & Laughlin	3 - 4	3
12.	Coleraine	Semi-taconite mag. &n.mag.	U.S. Steel Corp.	7 - 8	6
13.	Crosby-Ironton Cuyuna Range	Semi-taconite	Various	5	2
			TOTAL MINNESOTA RANGES - Some 13 plants		95

Source: Eugene P. Pfleider. Address before the Annual Meeting of the American Iron Ore Association, Minneapolis, Minn. August 1964.

Table 38

WORLD IRON ORE - 1965
(as of January 1st)

ANNOUNCED IRON ORE EXPANSION AREAS
(Not including Pellet plants)

Country	Property or Deposit	Proposed 1970 Annual Production Gross tons
AFRICA		
Angola	Mombassa	2,500,000
Egypt	Bahariya	2,200,000
Guinea	Conakry	5,000,000
Liberia	Lamco	10,000,000
	Delimco	3,000,000
	National	4,000,000
Mauritania	Miferma	6,600,000
Sierra Leone	Marampa	3,000,000
South Africa	Iscor	3,300,000
	AFRICA TOTAL	39,600,000
ASIA		
Australia	Various	2,500,000
Hong King	Various	250,000
India	Various	22,000,000
Philippines	Various	250,000
	ASIA TOTAL	25,000,000
EUROPE		
Russia	Various	48,000,000
Sweden	LKAB	11,000,000
Yugoslavia	Ljubija	1,200,000
	EUROPE TOTAL	60,200,000

ANNOUNCED IRON ORE EXPANSION AREAS Cont'd.

Country	Property or Deposit	Proposed 1970 Annual Production Gross tons
NORTH AMERICA		
Canada	Various	10,000,000
Mexico	Las Encina	1,300,000
United States	Various	5,000,000
	NORTH AMERICA TOTAL	16,300,000
SOUTH AMERICA		
Argentina	Somisa	500,000
Brazil	Itabira	13,000,000
	Cosigua	10,000,000
	Minas Gerais	4,000,000
Chile	Sante Fe	7,000,000
	Bethlehem	3,000,000
	Gran Mineria	5,000,000
Peru	Marcona	10,000,000
	SOUTH AMERICA TOTAL	52,500,000
	WORLD TOTAL	193,600,000

Source: Iron Ore Association.

Table 39

IRON ORE PRODUCTION BY COUNTRIES
Million of Gross Tons

COUNTRY	1948	1953	1958	1963
United States	101.0	118.0	67.7	72.3
Canada	2.7	5.8	14.0	25.0
Brazil	1.5	3.6	5.1	12.9
Peru	-	1.0	3.5	5.4
Chile	2.5	2.9	3.7	7.8
Venezuela	-	2.3	15.2	11.9
Czechoslovakia	1.4	1.7	2.8	3.4
France	22.7	41.8	58.5	57.6
West Germany	7.2	14.4	17.7	12.7
Sweden	13.1	16.7	18.0	22.1
Russia	29.5	59.0	87.4	136.8
United Kingdom	13.1	15.8	14.6	14.8
China	.2	5.6	29.5	49.2
India	2.3	3.9	6.0	14.0
Algeria	1.8	3.3	2.3	1.8
Liberia	-	1.3	2.3	3.5
Sierra Leone	1.0	1.4	1.3	1.8
South Africa	1.1	1.9	2.2	4.3
Australia	2.0	3.3	3.9	4.9
Other Countries	12.4	29.1	43.0	59.1
WORLD TOTAL	215.5	332.8	398.7	521.3

Source: Iron Ore Association.

Table 40

RECORD IRON ORE CARGOES
SHOWING GROWTH IN TONNAGE CARRIED
1904 - 1962

1962	Ryerson, E. L.	27,742	1945	Voorhees, E. M.	18,429
1962	Murray Bay	26,919	1945	Coulby, Harry	16,764
1962	Red Wing	26,924	1944	Fairless, B. F., net	20,456
1962	Ryerson, E. L.	24,520	1943	Fairless, B. F., gross	18,264
1961	McWatter, J. N.	24,316	1942	Lemoyne	17,082
1961	Cadillac	13,430	1941	Coulby, Harry	16,335
1961	Frontenac	13,187	1940	Coulby, Harry	15,974
1960	Murray Bay	24,180	1939	Block, L. E.	15,778
1960	Fitzgerald, E.	25,172	1938	Block, L. E.	15,726
1960	Murray Bay	26,043	1937	Coulby, Harry	15,684
1960	Red Wing	25,648	1929	Coulby, Harry	14,617
1959	Menihek Lake	23,291	1928	Donnacona	14,985
1957	Humphrey, G. M.	19,303	1927	Donnacona	14,532
1956	Misener, Scott	20,098	1920	Col. J. M. Schoonmaker	14,010
1955	Clarke, P. R.	21,168	1920	E. W. Pargny "Gary"	13,864
1955	Humphrey, G. M.	22,289	1920	W. J. Filbert	13,912
1954	Humphrey, G. M.	22,379	1918	W. P. Snyder	13,654
1953	Weir, E. T.	20,681	1917	W. P. Snyder	13,642
1953	Greene, E. B.	20,316	1917	Kerr, D. G.	13,732
1953	McKellar, J. O.	20,209	1916	W. P. Snyder, Jr.	13,694
1951	Coverdale	18,330	1916	Col. J. M. Schoonmaker	13,525
1951	Sykes, W.	18,929	1906	H. H. Rogers	13,333
1950	Coverdale	17,917	1905	E. H. Gary	12,003
1950	Sykes, W.	18,929	1904	A. B. Wolvin	10,300
1947	Fairless, B. F.	18,725			
1945	Fairless, B. F.	18,593			

Source: Green's Great Lakes Directory.

TABLE 41

PHYSICAL CHARACTER OF THE
ST. LAWRENCE SEAWAY - GREAT LAKES WATERWAY

Channels and Lakes	Length (miles)	Depth (feet)	No. of Locks	Maximum Ship Size (1)	Elevation (Feet)
Sea to Montreal	1,000	35	-	-	0 - 19
Seaway					
Canadian section	68	27	4	730x75x25.5	-
International section	46	27	3	730x75x25.5	-
Thousand Island section	68	27	-	-	-
Lake Ontario	170	-	-	-	246
Welland Canal	28	27	8	730x75x25.5	-
Lake Erie	245	-	-	-	572
St. Clair & Detroit Rivers	88	27	-	-	-
Lake Huron	350*[2]	-	-	-	580
Lake Michigan	380*	-	-	-	580
Straits of Macinac	20	27	-	-	-
St. Mary's River	63	27	-	-	-
Sault Canals	(one lock length)	16 to 31	5 (parallel)	730x75x25.5[3]	-
Lake Superior	395	-	-	-	-

(1) Maximum length, beam and draft of ship which can be handled by the locks.

(2) Approximate

(3) Maximum size of ship which can be handled in the largest of the U. S. locks. The new U. S. Poe lock when completed will be able to handle ships up to 1000 feet long and of 100 feet of beam.

ST. LAWRENCE SEAWAY TRAFFIC STUDIES

APPENDIX B

Potential Grain Traffic on the
St. Lawrence Seaway to 1985

Prepared by:

J. Kates & Associates
20 Spadina Road
Toronto 4, Ontario

for

THE ST. LAWRENCE SEAWAY AUTHORITY

Author - H.A. Luckhurst
Project Director - R.M. Campbell

December, 1965

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SUMMARY

The Continent of North America will continue as the only major grain surplus area of the world, probably supplying 80% to 90% of deficit needs during the period under review. The St. Lawrence Seaway, reaching as it does into the very heart of the grain growing areas of the Continent, will naturally provide one of the major routes through which this grain will flow.

Total grain traffic through the St. Lawrence Seaway and Welland Canals is expected to increase as follows :-

A Welland Canal (Millions of short tons)

Year	United States	Canada	Total
1964	6.73	10.32	17.05
1970	8.25	9.61	17.86
1980	11.30	11.25	22.55
1985	12.80	12.53	25.33

B Montreal - Lake Ontario (Millions of short tons)

Year	United States	Canada	Total
1964	6.07	9.38	15.45
1970	8.00	8.96	16.96
1980	10.80	10.30	21.10
1985	12.30	11.25	23.55

In the United States, the routing of the export grain traffic is determined mainly by the free play of competition between the export sectors themselves (Lake, Gulf, Atlantic, Pacific) and the inland carriers serving the various areas. In Canada, however, the routing of the export grain traffic is managed by an agency of the Federal Government, the Board of Grain

Commissioners. The Board takes into consideration the location of the export market, total distribution costs and the adequacy of grain handling facilities.

As far as the size of the movement is concerned, Canadian grain volume moving eastward will depend largely on the volume of production and the requirements of grain in eastern Canada. The conditions which determine American grain tonnages through the Seaway are more complex and difficult to analyze as they depend to a large degree on a number of government policies.

The present pattern of United States grain movements reveals a large increase in the Seaway share of this traffic is possible and the volume could be much greater than that of Canada. The United States hinterland to the Seaway produces roughly 70% of all U.S. grain, but only 15% of all export grain is normally handled by the Seaway. Increased movement has been consistently inhibited by intense competition from the traditional routes - Gulf, Atlantic and the Pacific - and especially from the carriers serving these areas. However, it is expected that by 1970 the Seaway's share of total grain exports is likely to climb to about 20% and by 1980 to about 22 % of total U.S. exports of grain. This improvement is predicated upon factors such as improvements in Great Lake's harbour facilities (additional elevator capacity, adequate depth of harbours, etc.) development of efficient ancillary services such as customs brokers, forwarders, banking facilities, railway rate modifications and to crumbling resistance to change in traditional trading patterns and routings. The

Seaway share of the U.S. grain exports is not expected to exceed 22 % because of the prospects of stiff railway competition based on trainload and integral train concepts.

In contrast to the United States, the bulk of Canadian production is exported each year and production is therefore an important determinant of water traffic in grain. Therefore, an analysis was made of Canadian production of grain and this was viewed in the light of two developments which are found to have taken place in the recent past :-

(1) The growing importance of the Pacific as a grain export route and

(2) The increasing movement of grain through the Seaway for domestic consumption in eastern Canada.

MEMO. TO: R.M. CAMPBELL

FROM: H.A. Luckhurst

DATE: November 15th, 1965

SUBJECT: GRAIN EXPORT FORECAST

Enclosed are copies of four Tables forecasting export of Canadian grain and world grain demand. (See pages 126 to 129.)

These Tables were basic to the forecast and conclusions reached in the original report, but were not included in the final version. I feel they should have been, not only because they are important to the report, but because they deal with the area that the Stanford Report leans on most heavily.

To back up our views, I have also prepared a brief memorandum dealing with Canadian grain export.

FURTHER COMMENTS RE EXPORTS OF CANADIAN GRAIN

In reviewing the Kates' forecast of exports of Canadian grain, there are a number of points which might be stressed in support of the contention that use of the Seaway for Canadian grain exports will continue to expand during the forecast period.

The principal export market for grain moving by the Seaway is Europe. Western Europe is by far the world's largest grain importing area and is likely to remain so over the forecast period. By the year 2000, Asia is expected to exceed Europe by a substantial extent, but in 1980-85 Europe will still exceed Asia.

This is shown in the attached Table A (for Addendum) 1. The one principal question mark is Eastern Europe. There is much disagreement about whether this area will be a net importer or a net exporter during the next 15 or 20 years. Earlier forecasts by the U. S. Department of Agriculture and F. A. O. anticipated the areas as a whole would be a net exporter by 1970, with all but Russia importing substantial tonnages, and Russia resuming her earlier role as a large exporter principally to the Eastern European bloc and probably to Cuba.

Developments in the past two or three years indicate that Russia has not, at least in the short run, increased grain production sufficiently to meet growing needs. The same is true in the satellite countries who are looking more and more to Canada and, perhaps in the future, to the U. S. for grain needs, especially wheat. The Table A-1 (formerly V-3A) has been revised to reflect these changes.

Looking at the forecast of Canadian grain exports to Europe, it becomes apparent that the forecast anticipates continuing strong sales in Canada's traditional markets of Western Europe, in line with the expected strong demand for imported wheat, coarse grains and oil seeds.

Canada's position in this market is bolstered by some special considerations which were covered in the original drafting of the study but which bear repeating here.

The foremost is, of course, the special position Canada's grain occupies. In spite of the fact European grain output (especially EEC countries) will increase substantially, European millers will need increasing amounts of Canadian hard wheat for blending with domestic wheat. The ratio of Canadian to total wheat consumed is rising and is expected to continue to increase.

Long term agreements and rising populations should ensure increasing demand for Canadian wheat in the balance of Western Europe. The coarse grain market situation appears equally promising, but sales will be restricted by availability of supplies. However, should Canadian wheat sales decline in the future, it is expected Canada could market equivalent tonnages of coarse grains and oil seeds. European consumption of these products is expected to accelerate rapidly, stimulated by increasing livestock output.

In the light of the revised demand picture, forecasts for sale of Canadian grain in this market appear very conservative. Wheat sales are expected to double to 1.2 million tons by 1970 from the 1962-63 sales of .68 million tons, and to rise slowly to 1.5 million tons by 1980. The pressure of the same demand factors as in Western Europe should sustain this tonnage at least, with every prospect of total sales being substantially higher.

Due to the uncertainties of this market, however, it is felt it would be unwise to revise the forecast upward at this time. Further study could, if desired, likely provide a much more specific and exact forecast.

One area where there is broad agreement as to market potential is Asia. There is expected to be a continuing rapid rise both in terms of total shipments and Canada's share.

It is felt, however, that the rise in sales will not affect Seaway shipments. In fact, increasing Asian sales are essential to the Seaway's continuing participation in grain traffic on the scale forecast for, unless the west coast facilities are heavily committed to Asian grain movement, then it will handle a larger proportion of the European tonnage.

Continuing Japanese demand and long term Chinese sales agreements, however, appear to ensure Canada a large Asian market for many years to come.

ACKNOWLEDGMENTS

Appreciation and gratitude are warmly expressed to the large number of people who willingly and helpfully gave their time, advice and knowledge during the research and writing of this study. Particular mention must be made of Robert Campbell, Project Director, and Julian Wood of J. Kates and Associates, Montreal, both of whom contributed data to the report and provided writing assistance.

Others whose contributions were of great value to the study include Mr. F. T. Rowan of the Canadian Wheat Board; Mr. Earle Baxter and Mr. Harry Swalwell of the Board of Grain Commissioners; Mr. James Clark and Mr. P. Huffman of the Winnipeg Grain Exchange, and a number of individuals associated with the Grain Trade and The Shippers' and Exporters' Association. These included Mr. K. A. Powell, President, K. A. Powell (Canada) Limited; Mr. Charles Kroft, President, McCabe Grain Company; Mr. Earl Green of Cargill Grain; Mr. J. Dallas of Continental Grain Company; Mr. F. W. Hamilton of Manitoba Pool Elevators; Mr. E. T. Titheridge of United Grain Growers and Dr. T. W. Grindley of the Maple Leaf Milling Company.

A number of people representing shipping and transportation interests were also very helpful. Among those contacted were Mr. E. N. Meyer of Inland Chartering Company; Mr. G. F. Bain of Upper Lakes Shipping; Mr. W. A. Robertson of Trans-Lake Chartering Ltd. and Mr. V. S. Stechishen, a freight rates consultant of Canada Transportation.

Others in Winnipeg who assisted include Mr. Bruno Lohner, a forwarding agent, and Mr. J. F. Brown, President of a Winnipeg implement manufacturing firm and importer of farm tractors and combines via the lakes.

In the general agricultural field, assistance was received from Mr. J. Parker, Director of Soils and Crops; Mr. A. Craig, Director of Publications and Statistics, and others in the Manitoba Department of Agriculture, and Drs. Clay Gilson and L. H. Shebeski of the Faculty of Agriculture at the University of Manitoba.

Discussions were also held with Federal Government officials in Ottawa including Mr. R. M. Esdale, Chief of the Grain Division, Department of Trade and Commerce, and Mr. J. M. Channon of the Department of Agriculture, and, along with a number of Dominion Bureau of Statistics officials, were among those who provided a good deal of helpful information.

Grateful acknowledgment is also made to the wide variety of people in the United States who provided information and who were helpful in many other ways.

Among those in the Chicago area who assisted were Mr. Robert Gaynor of the Canadian Consulate who arranged appointments and interviews; Mr. Robert C. Liebenow and Mr. Carl J. Lessing, President and Vice-President, Transportation, respectively, of the Chicago Board of Trade; Mr. Maxim M. Cohen, General Manager, Chicago Regional Port District; Mr. Gerald E. Franzen, Director, Transportation Division, Chicago Association of Commerce and Industry, and Edwin Draine, of Loyola University, a transportation expert doing transportation research for the Association of Commerce and Industry.

Representatives of Grain Companies and shipping firms in Chicago contacted and who were also helpful include Mr. B. S. Gaffrey of Cargill Grain Company; Mr. Julius Meyer, Continental Grain Company; Mr. Howard Oswald of Phelps Agencies, a vessel brokerage firm, and Mr. McArthy of American Export.

In Duluth, those assisting include Mr. Robert T. Smith and Mr. Robert H. Smith, Port Director and Director of Traffic for the Port of Duluth, respectively; Mr. Robert Tomich, Manager, Public Marine Terminal; Mr. Robert Baker, of Alastair Guthrie Inc., and Mr. G. F. Hubbard of Boland and Cornelius Vessel Brokers, representing a number of members of European and Oriental Shipping lines, including the Manchester Line.

Mr. Charles Donley and Mr. P. F. Chimento, of Charles Donley and Associates of Pittsburgh, assisted with the study.

SUMMARY TABLE

INTERIM ST. LAWRENCE SEAWAY TRAFFIC FORECASTS
TOTAL GRAIN SHIPMENTS - DOWNBOUND
WELLAND CANAL & MONTREAL - LAKE ONTARIO SECTORS

Millions of Short Tons

Year	Welland Canal			Montreal - Lake Ontario		
Actual*	Canada	U.S.A.	Total	Canada	U.S.A.	Total
1959	4.53	3.26	7.79	3.89	2.69	6.58
1960	5.02	3.92	8.94	4.17	3.29	7.46
1961	6.97	4.33	11.30	6.08	3.77	9.85
1962	5.57	5.93	11.50	4.97	5.26	10.23
1963	7.82	6.31	14.13	7.12	5.65	12.77
1964	10.32	6.73	17.05	9.38	6.07	15.45
Forecast						
1965	10.9	7.2	18.1	10.1	6.5	16.6
1966	7.7	7.4	15.1	8.9	6.8	15.7
1967	8.7	7.7	16.4	7.7	7.2	14.9
1968	9.1	7.9	17.0	8.1	7.4	15.5
1969	9.3	8.1	17.4	8.5	7.7	16.2
1970	9.61	8.25	17.86	8.96	8.0	16.96
1971	9.8	8.5	18.3	9.0	8.2	17.2
1972	9.9	8.9	18.8	9.25	8.5	17.75
1973	9.9	9.2	19.1	9.4	8.9	18.3
1974	10.2	9.5	19.7	9.4	9.1	18.5
1975	10.5	9.9	20.4	9.6	9.5	19.1
1976	10.6	10.3	20.9	9.8	10.0	19.8
1977	10.9	10.7	21.6	10.0	10.3	20.3
1978	11.0	10.9	21.9	10.1	10.5	20.6
1979	11.2	11.1	22.3	10.25	10.6	20.85
1980	11.25	11.30	22.55	10.3	10.8	21.1
1981	11.3	11.7	23.0	10.4	11.1	21.5
1982	11.6	12.0	23.6	10.5	11.6	22.1
1983	11.9	12.3	24.2	10.75	11.9	22.65
1984	12.2	12.6	24.8	11.1	12.1	23.2
1985	12.53	12.80	25.33	11.25	12.3	23.55

* Source: St. Lawrence Seaway Report.

SUMMARY TABLE

INTERIM ST. LAWRENCE SEAWAY TRAFFIC FORECASTS
CANADIAN GRAIN - DOWNBOUND
WELLAND CANAL & MONTREAL - LAKE ONTARIO SECTORS

Millions of short tons

Year	Welland Canal			Montreal - Lake Ontario		
Actual**	Wheat	Coarse Grains*	Total	Wheat	Coarse Grains	Total
1959	3.23	1.30	4.53	2.89	1.00	3.89
1960	3.67	1.32	5.02	3.16	1.01	4.17
1961	5.86	1.11	6.97	5.24	0.85	6.08
1962	4.37	1.20	5.57	3.99	0.98	4.97
1963	6.30	1.52	7.82	5.90	1.22	7.12
1964	8.90	1.41	10.32	8.30	1.08	9.38
Forecast						
1965	9.5	1.4	10.9	9.0	1.1	10.1
1966	8.3	1.6	9.9	7.7	1.2	8.9
1967	7.0	1.7	8.7	6.4	1.3	7.7
1968	7.2	1.9	9.1	6.7	1.4	8.1
1969	7.3	2.0	9.3	6.9	1.6	8.5
1970	7.5	2.1	9.61	7.2	1.75	8.96
1971	7.7	2.1	9.8	7.3	1.7	9.0
1972	7.9	2.0	9.9	7.5	1.75	9.25
1973	8.0	1.9	9.9	7.6	1.8	9.4
1974	8.2	2.0	10.2	7.7	1.7	9.4
1975	8.4	2.1	10.5	8.0	1.6	9.6
1976	8.5	2.1	10.6	8.1	1.7	9.8
1977	8.7	2.2	10.9	8.3	1.7	10.0
1978	8.8	2.2	11.0	8.4	1.7	10.1
1979	8.9	2.3	11.2	8.5	1.75	10.25
1980	8.97	2.28	11.25	8.52	1.78	10.30
1981	9.0	2.3	11.3	8.6	1.8	10.4
1982	9.2	2.4	11.6	8.7	1.8	10.5
1983	9.5	2.45	11.9	8.9	1.85	10.75
1984	9.7	2.5	12.2	9.3	1.8	11.1
1985	10.0	2.53	12.53	9.4	1.83	11.25

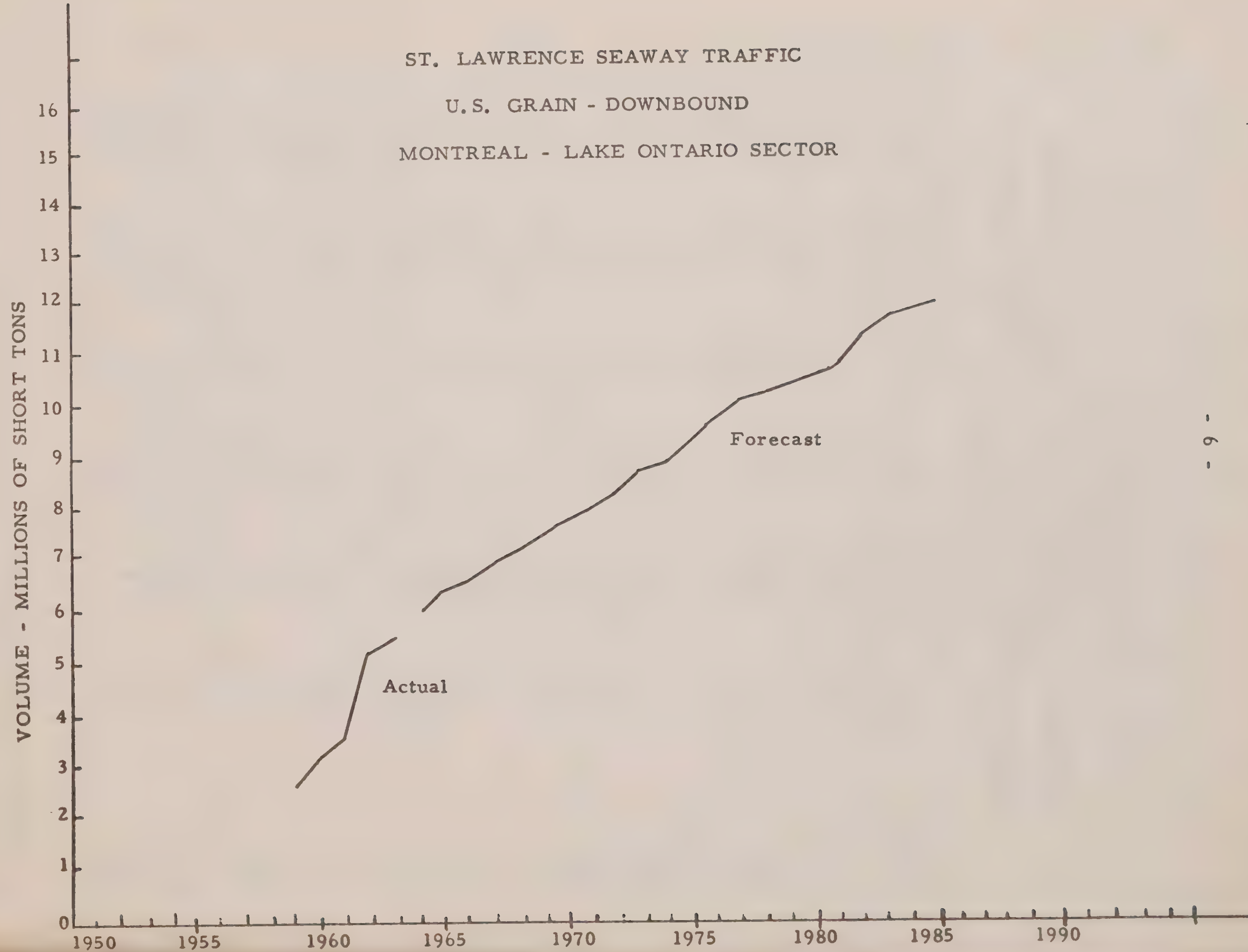
* Includes Rye, Oats, Barley, Flax.

** Source: Traffic Reports of the St. Lawrence Seaway.

ST. LAWRENCE SEAWAY TRAFFIC

U.S. GRAIN - DOWNBOUND

MONTREAL - LAKE ONTARIO SECTOR



ST. LAWRENCE SEAWAY TRAFFIC

CANADIAN GRAIN - DOWNBOUND

Welland Canal

PREFACE

Terms of Reference

This study forms part of the work undertaken to provide the St. Lawrence Seaway Authority of Canada and the Canadian Seaway Tolls Committee with estimates of total traffic volume expected to pass through the Seaway in future years. The particular forecasts made in this study pivot on the periods 1970, 1980 and 1985.

Methodology

Many aspects of the grain trade of both Canada and the United States remain the subject of special studies, continuing reviews and statistical documentation. Much of the emphasis in this study is directed to critical evaluation of some of these sources of information, forecasts and opinions bearing on future developments. Many interviews were held with interested parties both in Canada and the United States. Numerous published and unpublished statistical compilations and analyses have been reviewed. Reliable forecasts and other data, particularly of supporting economic indicators, have been used whenever pertinent to the study. Careful attention has been paid to movement of grain according to type, use and destination.

The report is divided into a summary and four main subdivisions. The St. Lawrence Seaway provides one of the major transportation links in the world grain distribution system and the first section describes the developing trade pattern of world grain and the growing importance of North American in relation to world grain requirements.

The second and third sections describe in greater detail the trade patterns within Canada and the United States. Attention is given to the changes brought about as a result of the construction of the Seaway and an assessment is made regarding future trends. The last section is concerned with the development of the forecasts themselves.

Limitations

The study and basic forecasts are based on certain customary assumptions, the most important of which are :-

(a) Normal political and economic climate (no world wars, cataclysmic depressions, etc.).

(b) Normal food demand patterns (e.g. no sudden change to vegetarianism).

(c) No substantial change in Seaway toll structures.

(d) No drastic change in transportation costs for grain, either rail, lake or ocean.

INTRODUCTION

The present study is concerned with that part of Seaway traffic which is generally included under the heading of grain. The term "grain" is used to cover all large volume movements of unprocessed cereal and feed grains and oil-seeds.

Wherever aggregate grain figures are presented, we will endeavour to show what commodities are included and their importance to the overall analysis. We believe that a brief description of marketing patterns and major end-uses of these major components might afford useful assistance to the reader in understanding what follows.

Wheat

Man's principal sources of food energy are rice and wheat; these two foods collectively supply 41% of total calorie intake. (All grains combined supply 53% of the total, although grains consumed indirectly in the form of meat, milk, eggs and animal fat account for a substantial part of the remaining 47%.) In the years to come, wheat will undoubtedly increase in importance as a staple commodity for the world's growing population. The major classes of wheat used for milling purposes, together with their approximate market importance are as follows :-

Class	Canada	U.S.A.
Hard red winter	1%	60%
Hard red spring	90%	20%
Soft red winter	-	10%
White wheat	3%	6%
Durum	6%	4%

Other commercial classes recognized are red durum and mixed wheat.

The chief food use is flour in the form of a baked product. The hard red winter and hard red spring wheats are used primarily for bread flours. Soft wheats, including white wheat, are used mostly for cake, cracker, cookie, pastry and family flours. Durum, a variety of hard wheat, is used mostly for making spaghetti, macaroni and other "pasta" products.

Hard wheats are grown in drier areas and have a higher protein (11% to 15%) and also a "stronger" gluten. Soft wheats are grown in more humid areas and have a protein content of around 8% to 10% with a "weak" gluten. As the quantity of protein and sometimes the quality vary, the flours of different wheats are often blended together to make flour suitable for many purposes and it is the surplus hard varieties of wheat which generally enter international trade.

The main producers of hard wheat in the United States are Kansas, North Dakota, Montana, Nebraska, Washington, South Dakota, Minnesota and Oklahoma. In Canada, almost all hard wheat is grown in the three prairie provinces. Soft red wheat is largely produced in Illinois, Indiana, Ohio, Missouri and Pennsylvania and soft white wheat in Washington, Oregon, Idaho and in parts of Ohio, Pennsylvania, New York and Ontario.

Coarse Grains

Coarse grains are used mainly for animal feed and industrial purposes and direct human consumption of coarse grains is relatively small in North America. The most important coarse grains are corn, barley, oats, rye, soy beans and flaxseed.

Corn - is the primary coarse grain and has three principal types; dent, flint and flour corn. Dent corn forms the bulk of United States production (about one half world production), which is concentrated in the north central States. Corn is also grown in Canada, principally in Ontario. This grain is used mainly for feed, although some is used to make starch, alcohol, corn syrup and corn oil and it is also eaten (mainly in North America) as corn-on-the-cob. It is a staple diet in certain countries of Latin America, Africa and eastern Europe, although often in the form of meal, hominy and grits.

Barley - is predominantly a feed grain, but a relatively large share goes into industrial uses, e.g. malt for the brewing industry.

Oats - is the only major grain whose production has fallen in recent years, mainly due to the reduction in the number of horses. The U.S. volume, about 15 million tons in the early 50's, has dropped almost 5 million tons since that time; in Canada it has fluctuated, but reached a high level of more than 7 million tons in 1962.

Rye - is used largely for industrial purposes (e.g. whiskey), but is also employed in the manufacture of rye bread. Europe is the main producer of this grain.

Soy beans - are grown primarily for processing, but some is also grown for hay and pasture, to furnish direct feed in the form of beans, or for soil rebuilding. Of the many edible and inedible uses of processed soy beans, by far the largest are in the form of oil for human consumption and cake and meal for animal feeding. Most of the United States production is concentrated in the north central States and down the Mississippi Valley.

Flaxseed - is used almost exclusively for the manufacture of linseed oil, which in turn is used in the making of paints, enamels, soaps, etc. Most of the Canadian flaxseed is grown in areas of average or low protein content wheat, e.g. the Goose Lake area, the Red River Valley, along the Manitoba - Saskatchewan border and in the irrigated areas of Alberta.

The Marketing of Grain

Grain flows to market on the U.S. and Canadian prairies much as rivers flow to the ocean. From thousands of primary

delivery points small streamlets rise which eventually jam the main rivers of grain. A major flow, and one with which we are mainly concerned in this report, is to terminals at the head of the Great Lakes. Another is to Pacific terminals at Vancouver, New Westminister, Victoria and Prince Rupert, whilst a large stream goes down the Mississippi Valley system to the port of New Orleans. Other streams flow to the U.S. Atlantic seaboard and to the port of Churchill on Hudson Bay. However, the mechanics of the marketing process are somewhat different in Canada and the U.S. and these will be briefly described.

Canada

The Canadian Wheat Board is the sole marketing agency for wheat, oats and barley produced in western Canada. * It also holds extensive powers over movement of other grains. Each year the Board makes arrangements with grain elevator companies to accept producer grain deliveries and to make the initial payments (in effect, a floor price) established for that crop year by the federal government. For each grain, a separate pool is established. When all deliveries of a given crop year have been marketed by the Board, the pool is closed. A final payment is made to the producer, based on the pool participation certificates with which he is issued at the time of grain delivery.

The Board is responsible for the control of grain movement in two ways :-

* Ontario wheat is marketed through the Ontario Wheat Producers' Marketing Board.

(1) By establishing delivery quotas for producers at country elevators.

(2) By shipping orders issued to elevator companies which must take into consideration available rail boxcars, terminal storage space and immediate and short-term market requirements for various grains and grades.

In actual marketing of the grain, the Wheat Board normally makes use of the shipping and exporting sectors of the private grade trade; these act as agents of the Board, not on a commission basis, but on what margin they can make above the Board's asking price. Occasionally, however, and particularly where credit sales are concerned, a foreign government or its agency may prefer to deal directly with the Board. The Board announces its selling prices each day at the close of the Winnipeg market; it takes into consideration prices of its competitors, the level of U.S. export subsidies, the relative qualities of Canadian and other wheats and the relative supplies of each type and grade of wheat.

The Winnipeg Grain Exchange remains as the logical focal point for the varied segments of the grain trade. The voluntary membership of the Grain Exchange includes representatives of both private and co-operative country elevator networks, the Canadian Wheat Board, shippers and exporters, millers, grain and feed merchants, commission merchants, foreign grain companies, grain brokers, banks, railway and shipping companies. The Canadian Wheat Board, responsible for the marketing of the three major western grains, makes its sales under the rules and regulations of the Exchange.

The division of function among public, private and co-operative agencies is perhaps best viewed by tracing grain movement from farm to ultimate market. Since 1949, delivery of the three major western grains has been accepted on the Wheat Board account by the country elevators. This represents more than 5,000 elevators in all with storage capacity of 367 million bushels, of which 60% belongs to farmer-owned systems, the balance to private enterprise. Payment for handling and storage charges are settled by annual agreement between elevator concerns and the Board. The Board controls movement of grain to terminal positions at the Lakehead, Vancouver and Churchill, allocating shipping orders to elevator companies on the basis of the previous year's grain deliveries.

With the grain in marketing position, the Board once again turns to the private grain trade to carry out much of the marketing function. Some forty companies, representing shipping and exporting interests, act as agents for the Board. Most of these firms have representatives in the major wheat importing nations of the world and many frequently act as principals in grain marketing transactions. In addition to these merchandising interests, there are a number of specialized functions involved in the marketing of grain such as financing, insuring, transporting and processing and these are carried out by individuals or firms on behalf of the Board, or its agents.

United States

In contrast to Canadian practice, grain marketing at all levels or points from producers to product consumer is conducted

through regular commercial channels and trade facilities.

Commercial marketing of grain begins at privately or co-operatively owned country elevators which have facilities for marketing, conditioning and storing grain. Grain may be hauled directly to the local elevator from the farm, usually by truck, as it is harvested or it may first be binned on the farm. Country elevators have many outlets for their grain; most of the wheat and coarse grain is sent on to terminal or sub-terminal elevators for further distribution, or to processing plants. However, considerable quantities of coarse grain may be sold locally to stockmen, dairymen and poultry men, or proceed directly to millers, feed manufacturers and feeders in deficit producing areas. The primary function of terminal market elevators is about the same as that of country elevators, that is, to receive, store and distribute. The principal difference is in the handling and storage capacity of the plants; also, terminal elevators usually hold grain in store for longer periods.

A large terminal market such as Chicago is equipped to provide many services and facilities for marketing, e.g. weighing and inspection services, drying, cleaning and storage facilities, trading floor privileges, market quotations, services of salesmen and commission merchants and services of financing, insurance and forwarding agencies. The price of grain established at the terminal markets, particularly at the Chicago Grain Exchange, continues to be accepted at the best measure of current values and the buying and selling of

operators in the terminals largely control the direct movements of grain in the domestic market as well as for export. Spot prices at terminal markets are greatly influenced by trends in the futures market.

The Commodity Credit Corporation, a government agency under the direction of the Secretary of Agriculture, has broad authority under its charter to conduct operations of a marketing nature. The C.C.C. is specifically empowered to support prices, procure commodities for various purposes, remove and dispose of surplus commodities to increase domestic consumption of agricultural commodities, and to export such commodities. In the export sector, grain is purchased by the C.C.C. under the domestic price support programs and either sold to private firms or disposed of under various U.S. government programs falling under sections of P-L. 480 and the Mutual Security Act.

PART I

NORTH AMERICA AND WORLD GRAIN

This section is designed to provide the necessary background information about world grain and the rapidly growing importance of North America as a supplier to the world market. The St. Lawrence Seaway plays an important role in the world distribution of grain and will probably play an even greater one in the years to come. The direction and strength of world export demand will therefore remain an important determinant of grain traffic volume proceeding via the Seaway route. One of the most important elements in the demand for food in general and grain in particular is the trend of world population.

Population and Grain

The world's population of three billion in 1960 is expected to reach between 6.3 and 6.9 billion by the year 2000 - an increase in forty years equal to the growth of population from the beginning of time, and in the ten-year period 1970 to 1980 it is expected to grow by over 700 million.

This increase is occurring in a highly uneven fashion with the greatest growth taking place in the so-called underdeveloped countries which are already heavily populated and have great difficulty in feeding themselves; this is particularly true of most of Asia, which already makes up about 56% of the total world population. North America, Europe, the U.S.S.R., Japan and Oceania have never experienced a rate of natural population increase comparable to that now facing the underdeveloped world: the highest decade rate of growth registered in this century by industrialised nations was about 12.8%, while the decade growth rate for the underdeveloped world is now 22.4% and

still rising.

The growth of population in itself would be serious enough, but the problem is magnified by the fact that these areas of greatest need do not have matching production potential, either as regards direct production of food or developing the productive capacity to purchase supplies from elsewhere. The increasing importance of wheat is a direct result of the harsh fact that the underdeveloped world, where rice is the traditional staple commodity, is rapidly losing the capacity to feed itself. It is therefore forced to turn to the developed countries for supplies of the second pricipal staple, namely, wheat. The only major surplus wheat area today is North America, since Latin America, the second traditional surplus area, has turned deficit since the second World War. In addition, Oceania remains a grain surplus area of minor but growing importance at present.

The significance of the deteriorating grain balance in the underdeveloped regions can be gauged from the fact that direct grain consumption now supplies about 53% of man's food energy, whilst a large part of the balance is supplied indirectly by grain in the form of meat and dairy products.

Grain Production and Trade

The growing regional disparity in the production of grain can be illustrated by means of the following table, showing total and per capita production by region :-

Total Production 1934-38	1948-52	1960-61	Region	Per Capita Production 1934-38	1948-52	1960-61
(millions of metric tons)				...... kilograms		
109	169	218	North America	768	1,006	1,107
31	31	44	Latin America	254	190	214
67	65	88	W. Europe	247	234	293
153	134	189	E. Europe & USSR	533	453	558
26	32	40	Africa	158	161	170
260	272	366	Asia	231	197	226
5	7	11	Oceania	455	538	688
651	710	956	World	307	284	328

These figures show that world production per capita has grown somewhat over the period, mainly as a result of increased production in the developed areas of the world, particularly North America and Oceania. The following data shows the excess over consumption demand available for export (+) or shortage to be met (-) associated with each region.

Total Balance Traded 1934-38	1948-52	1960-61	Region	Per Capita Balance 1934-38	1948-52	1960-61
(millions of metric tons)				.... kilograms		
+ 5	+23	+39	North America	+37	+139	+200
+ 9	+ 1	0	Latin America	+74	+ 5	- 2
-24	-22	-25	W. Europe	-88	- 79	- 84
+ 5	n.a.	0	E.Europe & USSR	+16	n.a.	+ 1
+ 1	0	- 2	Africa	+ 4	- 2	- 9
+ 2	- 6	-16	Asia	+ 2	- 4	- 10
+ 3	+ 3	+ 6	Oceania	+252	+256	+372

Most of the deficit has been met by growing shipments of grain from North America which, by 1960-61, were proceeding increasingly towards Asian countries. It is expected that by 1970 net exports of North American grain will reach 55 million metric tons and by 1980, 69 million metric tons. The requirements are likely to be much greater than this, but limited foreign exchange and purchasing power, inadequate port

and transport facilities and lack of well-developed distribution systems will impose severe restraints on the volume of exports to the underdeveloped countries which will take the bulk of these increased volumes. The forecasts made in this study are not based on any speculation about possible new approaches to foreign aid which might drastically alter the volumes and patterns of grain exports.

Wheat

Wheat remains by far the world's most widely traded commodity and has become increasingly important since World War II. In the 1959-61 period, average annual exports were 41 million metric tons, which represents 19% of world production. Wheat imports of 15.6 million metric tons by the diet deficit areas were one fourth of that area's supply available for food. The pattern of this trade has changed dramatically over the last 25 to 30 years, however, ~~as~~ the following data shows :-

	Net Exports in 1000 metric tons		
	1934-38	1948-52	1960-61
North America	5,258	17,999	27,110
Latin America *	1,777	- 849	-2,250
W. Europe *	-10,630	-13,317	-10.858
E. Europe & USSR	2,113	n.a.	746
Africa	105	-1,149	-2,970
Asia	- 870	- 5,121	-14,225
Oceania	2,727	2,921	4,805

*Certain countries within deficit groups were net exporters, e.g. Argentina, Uruguay, France, etc.

Previously the wheat trade patterns were based on sources of net regional surpluses well distributed throughout the world, but today 85% of the deficit is supplied by the North American Continent. The share of the world deficit filled by North American wheat may increase still

further in the years ahead despite rapid growth in Oceania. Total exports of wheat from the United States and Canada are expected to move as following during the period to 1985 :-

Year	Canada	United States	Total
	Millions of Short Tons		
1962/63	9.05	21.05 *	30.10
1963/64	16.17	19.40 *	35.57
1970	12.12	24.90	37.02
1975	13.04	26.70	39.74
1980	14.45	28.50	42.95
1985	15.70	28.50	44.20

* calendar years

Coarse Grains (including rice and soy beans)

The trends apparent in the case of wheat have been duplicated as far as coarse grains are concerned. North America accounted for a negligible share of net regional exports during the period 1934-38, but by 1960-61 the percentage had risen to almost 95%. Oceania accounted for all but a small fraction of the balance. Even in the case of rice, North American exports had risen almost to the level of those from Asian countries by 1960-61. The outlook for the future is for North America, particularly the United States, to continue to dominate as a source of coarse grains for deficit areas. The growth of exports of U.S. soy beans looks particularly promising since this commodity will probably become the major source of protein for underdeveloped regions. Exports of coarse grains are likely to develop in accordance with the following table :-

Year	Canada	United States	Total
	Millions of Short Tons		
1963	1.08	16.90	17.98
1970	2.07	21.90	23.97
1975	2.40	26.32	28.72
1980	2.78	30.75	33.53
1985	3.08	30.75	33.83

We should warn that the figures projected above, which are based on various estimates of the U.S. Department of Agriculture and the Canadian Wheat Board, are rough guides at best. Agricultural commodity projections are likely to be rather less dependable than those for industrial products where it is necessary to contend primarily with the business cycle whose beginnings and ends are fairly well defined and well known. In agriculture, we must abstract not only from the fluctuations caused by more hazily defined agricultural economic cycles, but from those resulting from the vagaries of weather and from the fluidity of a productive complex whose "plant" is readily adaptable to a variety of uses and whose very decentralised decision-making process is quickly and significantly influenced by almost random changes in market conditions and the details of government control, but only slowly and uncertainly by the stream of technological development.

NOTE: The information contained in this part has been taken mostly from the United States Department of Agriculture world food budget studies . See page 134 of this report for a list of reference material.

PART II

CANADIAN GRAIN AND THE ST. LAWRENCE SEAWAY

Canadian grain production has averaged about 1.1 billion bushels per year during the past twelve years, of which 45% has been wheat (see Table 2). Wheat acreage has increased during this period from an average of 24.7 million acres between 1952-56, to 29.6 million acres in 1964. Concurrently, coarse grains acreage has dropped from 20.1 million acres to 14.4 million acres.

Wheat and coarse grain acreages are not expected to increase in the future, but production could be substantially expanded through increased yields, stimulated by strong export demand for wheat and rising domestic coarse grain consumption.

The relatively stable yields of past years are expected to improve substantially in the future, with the introduction of new strains of grain, improved weed control and increased use of fertilizer.

The technology of agricultural production continues to have a considerable effect upon output. The replacement of horses by tractors as a source of farm power released ten acres of land for every horse, or one hundred acres for every tractor. (In wheat farming one tractor replaces roughly ten horses.) Between 1950 and 1960, seven million acres were released and a further two-and-a-half million will be released by 1980. There has also been a tendency to reduce summer fallow acreage, a further step towards more intensive farming. This illustrates the general direction in which agriculture is moving, but it will be useful to examine both the impact of tech-

nology on productivity of land and on crops themselves in further detail.

Productivity of Land

It is estimated that field crop production could be increased by 50% if all recommended soil management and fertility practices were followed. This would mean an increase in average annual production (based on 1956-61 average) of over 220 million bushels of wheat, 225 million bushels of oats and 110 million bushels of barley. More than half the farms of western Canada, for example, had not used fertilizer as late as 1960. Consumption of fertilizer per acre, however, is expected to double by 1970 over current use and fertilizer plants and mixing centres are being built up rapidly to meet increasing demand.

Crop Yield

Although the average yield of wheat over the ten year period 1951-60 rose to 20.5 bushels per acre, compared with 16.4 bushels per acre average between 1908 and 1950, this was due more to exceptional growing conditions than to the application of more advanced technology.

Most research effort has been directed toward developing varieties of grain resistant to disease and insects. Conventional methods of plant breeding do not appear to offer hope for increasing yield of cereal crops, barring a breakthrough similar to hybrid corn.

New techniques and new approaches to grain research appear to offer much promise. One area is in chromosome substitutions which could lead to great advances, but may be only an intermediary step in the development and use of entirely new grains. Hybrid wheat, only a dream a few

years ago, is now expected to be in commercial production in the early 1970s. It is anticipated that such an achievement could mean an increase of 100 million bushels a year in Canada, or about 20% of current farm production. Further, it is believed that this development can be achieved without loss of protein quality or quantity.

There is also constant effort to produce earlier developing varieties of corn, soy beans, sunflowers, etc. and a breakthrough in any of these could have a major effect upon the agricultural economy. One such change appears to be taking place at present with regard to rapeseed; it has been discovered that the fatty acid content can be interchangeable and, as a result, varieties can be developed to meet specific fatty acid specifications. Under these conditions no other oil crop in western Canada equals the production per acre of rapeseed and greatly expanded production is expected. As rape grows best in the north it will replace wheat in certain northern grain growing areas and, since wheat yields are highest in such areas, there could thus be a significant reduction in output. Protein content, on the other hand, is lower in these areas than in the south and, as a result, total wheat production could have a higher average protein content.

Pest control, plant disease and weed control are also becoming more effective through advancing technology, and again the results are reduced losses and increased productivity. It is estimated, for example, that wild oats alone has cost western farmers over 100 million bushels of grain a year through reduced yields and this battle is regarded as nearly over. Similarly, research into better forage crops, only begun in Canada, has increased yields by about one-third of a ton per acre since 1945. Since

Canada has $21\frac{1}{2}$ million acres of hay and pasture-land, this increased productivity has meant 6.8 million tons more forage crops per year, worth over \$100 million. Crop management will also be important to maximize production. A rotation system of grazing has been found to be 30% more productive than conventional continuous grazing methods.

CHAPTER II

DISPOSITION OF GRAIN

Domestic Consumption

Canada currently consumes about one-third of her annual wheat production, or about 4.5 million tons. Domestic demand has increased gradually over the years due mainly to rising population. However, with better living standards per capita consumption has dropped. Most of this wheat is consumed on the prairies for feed and seed (an average of 2.72 million tons between 1959-64), but an average of 1.68 million tons have been shipped to eastern Canada annually.

Canada consumes nearly all her coarse grain production. Of an average annual output of 13.4 million tons between 1959 and 1964, 10.6 million tons have been consumed on the prairies, while an average of 1.53 million tons went for domestic use in the east.

Grain Exports

Markets for Canadian wheat and other grains have remained relatively strong during the mid and late '50s, although below the all-time peaks of 1950-52. During the '60s, the period covering the opening of the Seaway to date, markets have increased appreciably and show signs of remaining at the high level of the past four years.

Wheat exports, as shown in the following table, have risen substantially, although coarse grains have not :-

Canadian Wheat Exports
Crop Years 1934/64

	1000 Tons
1934/5 - 1943/4 (avg.)	4,361
1944/5 - 1953/4 (avg.)	6,309
1954/55	6,268
1955/56	7.938
1956/57	6,739
1957/58	8,137
1960/61	9,346
1961/62	9,735
1962/63	9,058
1963/64	16,233

Source: Canadian Grain Exports

Although similar data for coarse has not been developed, exports in bushels 1953/54 to 1963/64 are as follows :-

Exports of Coarse Grain
1953/54 - 1963/64

Year	Mil. Bu.
1954/55	78.5
1955/56	57.5
1956/57	78.5
1957/58	73.8
1958/59	75.1
1959/60	61.4
1960/61	45.1
1961/62	44.6
1962/63	45.5
1963/64	67.1

Source: Canadian Grain Exports

Exports of wheat and coarse grains and the total export of these grains for calendar years are also available as shown for the years 1958 to 1964 in the following table :-

Canadian Grain Exports
1958 - 1964
('000 Tons)

Year	Wheat	Coarse Grains	000 Short Tons Total
1958/59	7,538	1,821	9,359
1959/60	7,514	1,494	9,008
1960/61	9,346	1,135	10,481
1961/62	9,735	1,126	10,861
1962/63	9,058	1,029	10,087
1963/64	16,233	1,561	17,794
		Average for Seaway years	11,265

Source: Canadian Grain Exports

Markets for Grain

Canadian wheat has sold in relatively stable amounts to traditional customers in Europe and in increasing amounts to Communist countries in Europe and Asia and non-Communist countries in Asia, particularly Japan and the Phillipines. There have also been moderate gains in the western hemisphere. Concurrently there have been reduced sales to African countries and India, Pakistan and adjacent countries. This has been due almost entirely to P-L.480 program of the United States which has captured these markets with free food grains and is now developing them as cash markets.

While not so obvious, it would appear that the stable or slightly declining markets in Europe and the slow rate of growth in Japan since 1958 are due in part to increasing U.S. sales there.

Wheat sales made on a commercial or cash basis have ranged from 250 to 375 million bushels a year over the past thirteen years,

reaching a peak of 515 million bushels in 1963-64 as a result of the Russian wheat sale, which has been repeated this season.

Government-assisted export sales have shown a substantial increase in the six years the Seaway has been open. In 1956-57 assisted sales were 10.9 million bushels of wheat, rising to a peak of 101 million bushels in 1961-62 and averaging about 87 million bushels a year over the past three years; this is shown in Table 4.

Expressed in terms of tons, commercial wheat exports have ranged between 7.4 and 15.6 million tons of wheat, while assisted sales have ranged from .1 to 3.0 million tons. Total grain exports have been between 9.0 million tons and 17.8 million tons between 1958 and 1964. Exports of coarse grains have proceeded largely to west European destinations, although about 578,000 tons, mainly barley to mainland China, was shipped to Asia during 1963/64. Compared to wheat, exports of Canadian coarse grains are small, lately averaging about 12% to 15% of wheat exports.

CHAPTER III

COST OF GRAIN MOVEMENT

A major determinant in the pattern of grain traffic, in addition to the location of markets in various areas of the world and the ease of reaching them via various routes, is the cost of reaching those markets. Table 5 shows the changes which have taken place in total shipment cost of grain by various routes from a mid-prairie point to the United Kingdom during the period the Seaway has been in operation.

Shipping Costs

Shipping costs have shown a consistent upward trend due, mainly, to increasing ocean freight rates. It will be noted that, in cost of shipping overseas, Churchill ranks lowest and the Pacific second. However, the margin over the St. Lawrence has been declining (12.4¢ and 9.7¢ respectively in 1957-58, to 9.9¢ and 1¢ respectively in 1963-64).

The major change has been the rise in ocean rates to Britain from the Pacific in 1963-64 and reductions in inland costs via the Seaway from 38.5¢ to 34.0¢ per bushel. Rates are expected to remain at about the 1963-64 level during the 1964-65 crop year.

The reduction in lake rates following the opening of the Seaway to date is as follows :-

Year	¢ / Bu.	$ / Ton
1958	16.0	5.33
1959	13.3	4.43
1960	13.0	4.33
1961	13.0	4.33
1962	11.6	3.85
1963	11.4	3.80
1964	11.5	3.82

Seaway tolls are 42¢ to 44¢ per ton, i.e. 9% to 12% of total rate to move wheat from the lakehead to Montreal, or approximately 1.3¢ per bushel. At present levels, tolls do not appear to be a significant factor.

Far more important are rail and ocean rates. To better appreciate the effect of the cost of moving grain from elavator to market and to try and establish the areas tributary to each export route or area, a comparison of cost of transport and handling has been prepared for various points on the prairies via the Pacific and Seaway. Table 6 shows the results based on 1963-64 crop year average costs.

It is immediately apparent that the breaking point for grain moving east and west is a line drawn north and south between Biggar and Saskatoon. While the line would not be perpendicular due to variations in distance on the C.N. and C.P.R., the dividing point is in this general area.

In earlier years when the ocean rate from Vancouver to Great Britain was about 4¢ lower and the lake rates were about 2¢ higher, the dividing point was much further east. However, movement via the St. Lawrence was not greatly affected for two reasons :-

(a) Pacific ports were operating at close to capacity due to large shipments to Asia.

(b) The Wheat Board absorbed the 5¢ saving via the Pacific and did not pass it along in the form of a price reduction on grain exported to Europe via this route.

The Canadian Wheat Board

Export sales are priced on a delivered basis and the net price received by the farmer is the average selling price of the crop, less average transport charges from point of origin to destination. The Board's assignment is to obtain the best average net price for the grain on the basis of long term marketing considerations.

Wheat for export is priced at the export terminals at rates which approximately equal the overseas delivered price, less the cost of ocean delivery. These prices are quoted daily as "basis in store Fort William, Port Arthur, Montreal, Churchill, Vancouver" etc.

The Board can regulate the flow of grain through the export terminals by slight variations in the prices quoted. Thus, if the ocean rate to the U.K. is 20¢ a bushel at Vancouver, the Board can quote a "basis in store" price at Vancouver which is sufficiently below the delivered price less 20¢ to provide brokers and ship operators the incentive to move more wheat. It can, and does, limit the flow by the reverse action. It can also use this pricing technique to move the grades it wishes to sell. As sales are made it arranges shipments to replenish the terminal elevator supples.

The distribution of the trade among the export terminals depends on the net-back afforded the farmer, the elevator capacity, the distribution of production, the location of customers and the general economic and political desirability of spreading the traffic out smoothly. At times, as in the case of the recent wheat sale to Russia, the customers specify the ports at which they wish to pick up the grain. (Russia refused

to consider Port Churchill.)

One result of the interplay of factors determining the direction and volumes of the grain movements is that the net-back at different ports and at different seasons vary. For instance, the western farmer receives a net-back of 8¢ to 9¢ less per bushel for grain shipped in the winter season through the Atlantic ports than he does in the Seaway season from the head of the Lakes or Lower St. Lawrence ports to the same overseas ports at the same delivered price. He has been getting a net-back of up to 5¢ more per bushel for grain shipped to Eurlpe via the Pacific than if it goes via the Seaway route. At present the export terminals rank in terms of the net-back to the farmer for shipments to Europe as follows: Pacific, Port Churchill, Lakehead, Lower St. Lawrence and, last of all, the Atlantic ports.

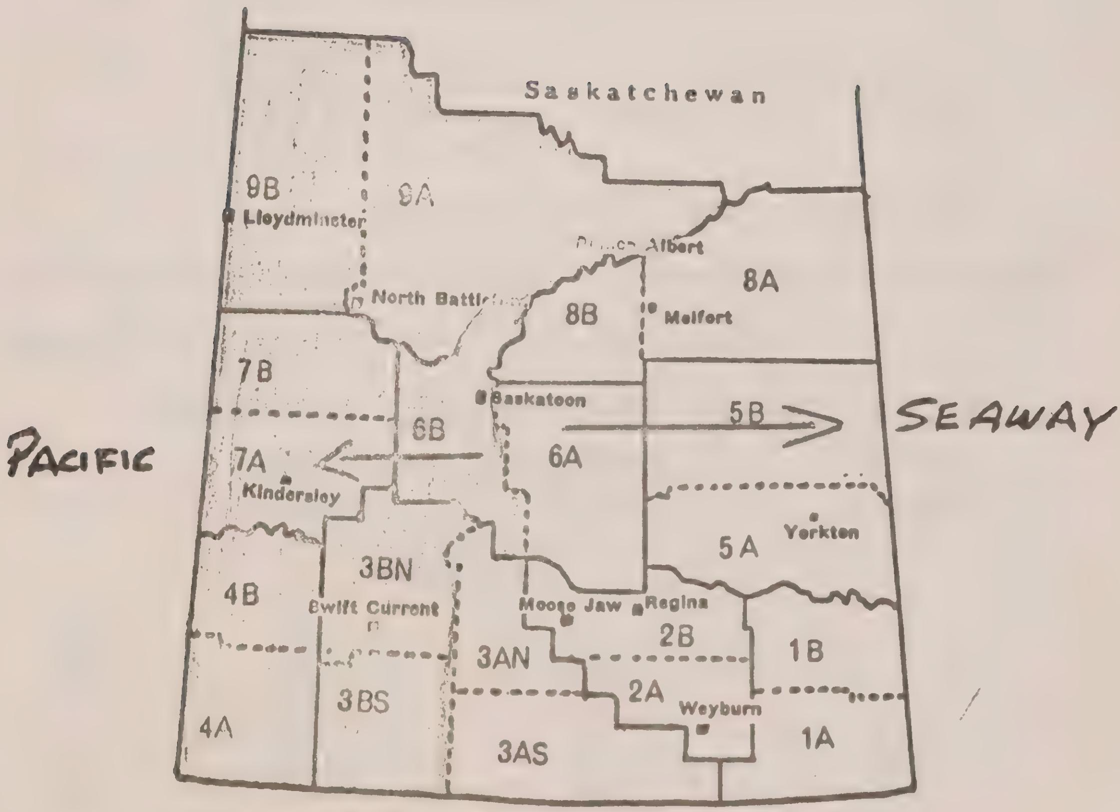
Only two factors presently restrict the greater use of the Pacific route. First, the inland cost of freight moves up as grain is taken from points further east on the prairies and secondly the grain handling capacity at the Pacific has been limited.

One side result of Board policy is that only a limited incentive is allowed for direct overseas shipping from the Lakehead because the Board's "basis in store" prices at these ports are higher than at the Lower St. Lawrence ports by amounts which largely reflect the savings to be had in direct shipping. This is not necessarily a bad policy, because it has meant a very economic operation for the large lakers carrying iron ore up the Seaway and grain down the Seaway to the Lower St. Lawrence ports.

The breaking point in rail rates between the Pacific and Lakehead appears to place about half the grain produced on the prairies in the

Pacific hinterland. To establish more closely the output of grain from the areas which can be regarded as tributary to the Pacific or the Seaway, production for the crop years 1962-63 was broken down according to production areas. The area considered the hinterland of the Seaway is all of Manitoba and the crop districts of Saskatchewan indicated on the map on page 36a. The hinterland of the Pacific is all of Alberta and the remaining area of Saskatchewan. Borderline areas are Crop Districts 3BS, 3BN and 6B, but for the purpose of this study these have been included in western Saskatchewan.

DIVISION OF SASKATCHEWAN CROP DISTRICTS INTO SEAWAY AND PACIFIC TRIBUTARY REGIONS



Map shows DBS crop districts and sub crop districts

CHAPTER IV

MOVEMENT OF PRAIRIE GRAIN 1958 - 1964

Before reviewing grain traffic via the Welland Canal and Ontario-St. Lawrence sector of the Seaway during the past six years and forecasting future traffic, it will be useful to examine the movement of grain through the Pacific and the Lakehead. In assessing the relative importance of these routes, it should be noted that :-

(1) All grain shipped to the Pacific is for export.

(2) All grain moving east, with the exception of grain shipped to Upper Bay and Lake ports, whether for export or domestic use, contributes to the Welland and/or Seaway traffic.

The total movement of grain is still principally eastward, because of the geographic position of the domestic and foreign markets. Since 1958 the pattern has not changed significantly.

Percentage of Grain Moved off the Praries by Terminals

Year	Pacific Terminals	Lakehead Terminals	Churchill Terminals
	%	%	%
1958	32	65	4
1959	34	61	5
1960	31	63	4
1961	35	61	4
1962	38	57	5
1963	35	61	4
1964	32	64	4

Source: See Table 9

The pattern of export movements has been dominated in recent years by the sales to Russia and Eastern European nations. These customers have a decided preference for the eastern terminals. Apart from these

sales, the share of overseas grain exports passing through Pacific terminals has been increasing steadily since the Seaway opened.

Percentage of Grain Exports by Terminals

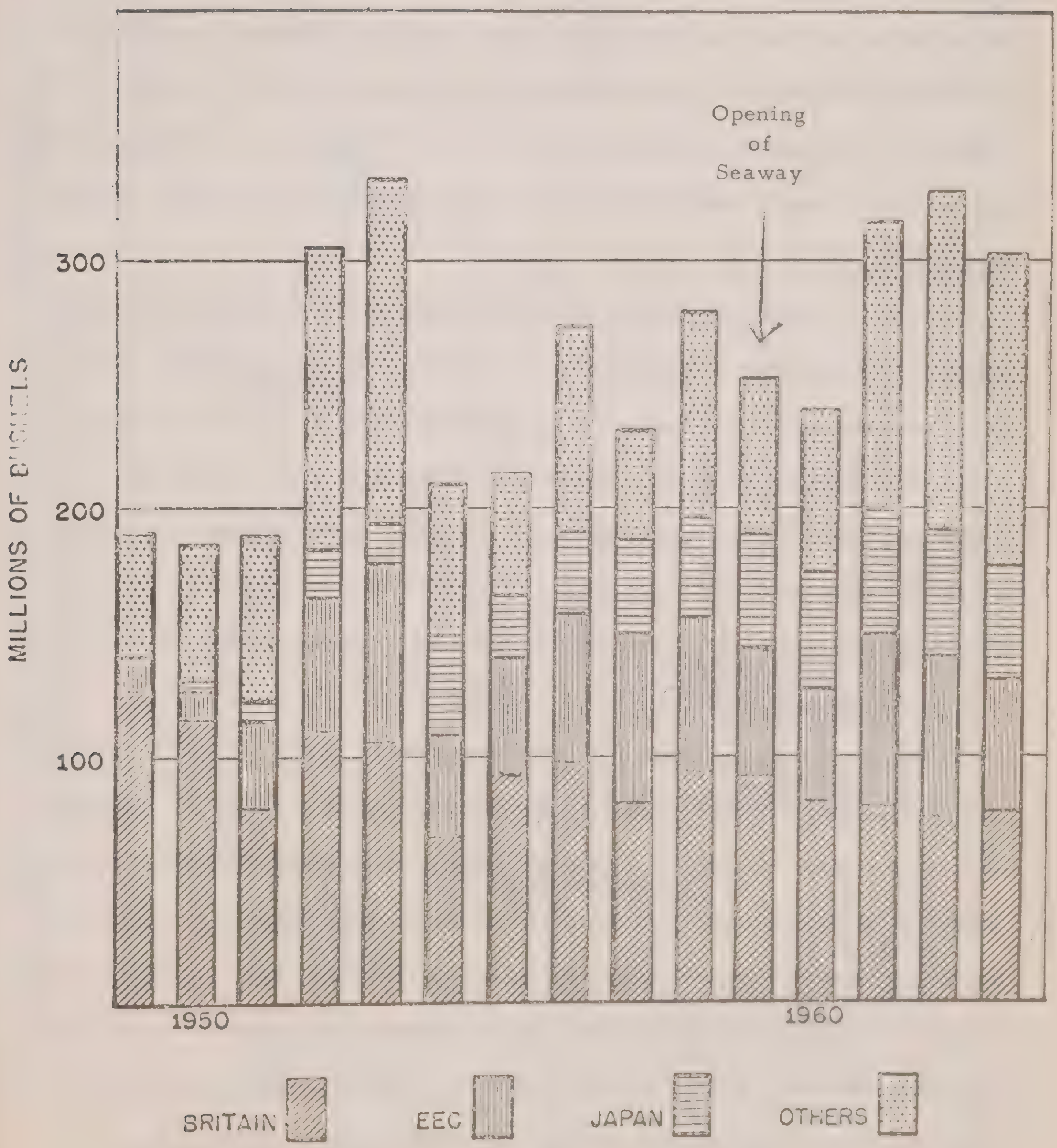
Year	Pacific Terminals	Eastern Terminals	Churchill Terminals
	%	%	%
1958	43	51	6
1959	47	46	7
1960	46	47	7
1961	45	50	5
1962	48	45	7
1963	41	54	5
1964	40	56	4

Source: See Table 10

Exports through the eastern terminals are funnelled principally through the Lakehead. The grain shipped out through the Atlantic ports moves only in the winter season, mainly because the net-back to the farmer is less by this route by 8¢ to 9¢ a bushel. Direct shipments from the Lakehead have not developed significantly. They are not entirely discouraged because the presence of some ocean vessels carrying grain directly overseas is considered by the Grain Board to be a strong incentive to Lake operators to keep their rates low. Many ocean ships might cause too much congestion at the Lakehead with present facilities and would raise the ire of inland shipping to the point of taking some collusive action.

While the cost of moving grain to Europe over the Pacific is close to, and at times less than, the cost over the Atlantic the Pacific route has inherent advantages for supplying markets in Asia, parts of central and South America and East Africa. With the development of new markets in these areas this has become a major route for Canadian grain exports.

CANADIAN WHEAT EXPORTS
1948-49 to 1962-63



Its share has risen from :-

14%, 1920-1929 to
32%, 1950-1959 to
44%, 1960-64

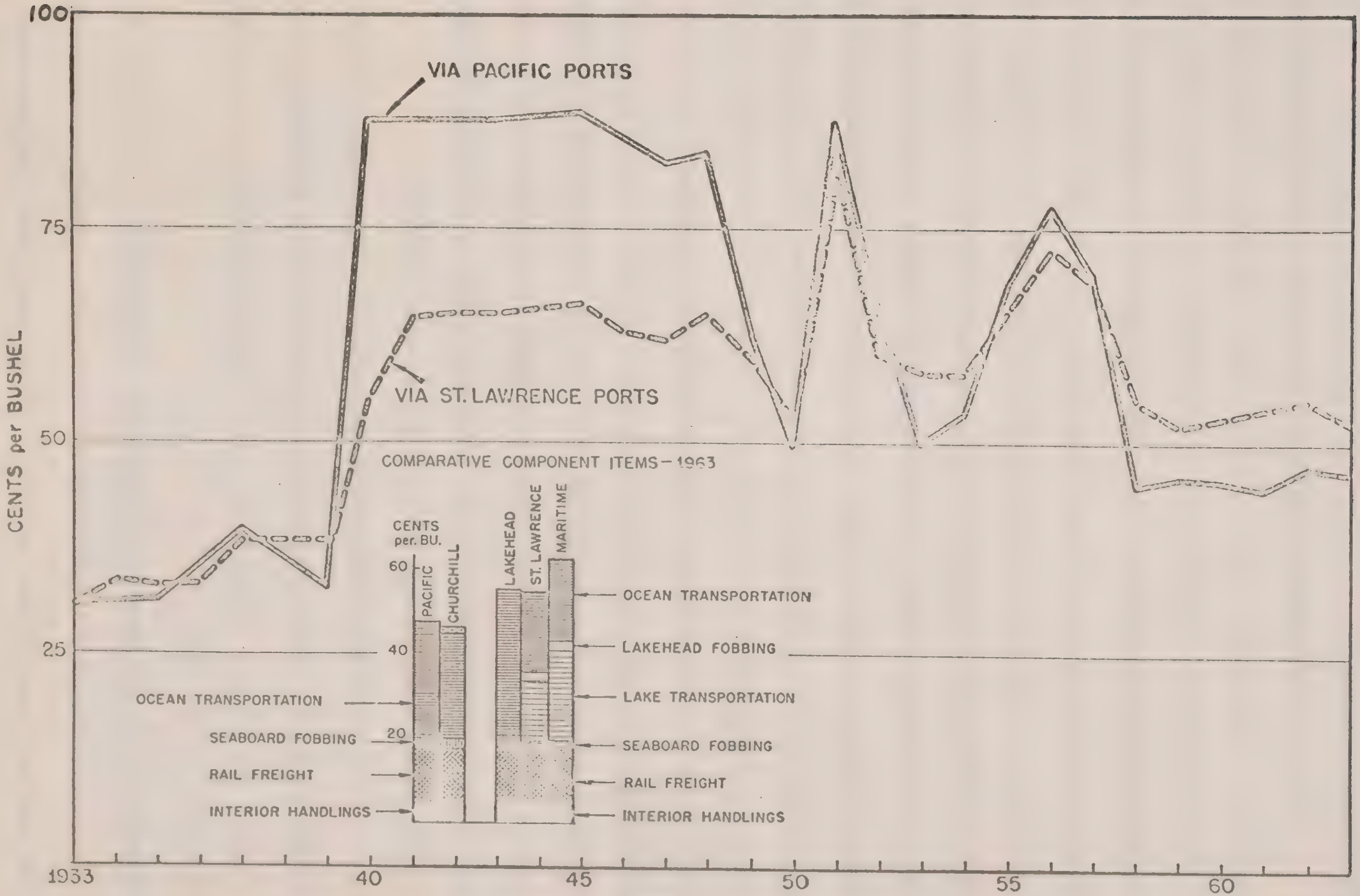
While Asian markets are important to the Pacific, this area has continued to handle European grain shipments and will likely do so in the future. This has an important bearing on the outlook for traffic on the Seaway which can be more clearly understood if we examine wheat exports more closely.

Wheat Exports

There has been a marked change in the destination of wheat exported through Pacific terminals. In earlier years a substantial part of these exports went to Europe, but as Asian markets grew increasing volumes were shipped to them. Meanwhile, exports to Asia via the St. Lawrence, while never large, declined to almost nothing. (See Table 13.) South American and African markets have been mainly served by the Pacific, while in recent years the Middle East is being served by the Seaway ports.

The significance of this is two-fold. First, as long as Asian markets remain strong the major movement of wheat through the Pacific will be for these markets. However, should Asian markets decline to any extent it is highly likely that the Pacific would again become a major route to Europe and thus would siphon off some of the wheat now moving to such markets by the Seaway. Secondly, since capacity has been a limiting factor on the west coast, growth in Pacific coast terminal capacity may enable the retention of Asian shipments and a revival of traffic to Europe.

AVERAGE COSTS OF MOVING WHEAT, CANADA TO THE UNITED KINGDOM SEASONS OF NAVIGATION 1933 to 1963



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Coarse Grain Exports

A breakdown of 1963 and 1964 coarse grain exports reveals that about 50% moved via the Pacific in 1963 and 65% in 1964. A breakdown by destination and route for the crop years 1962-63 and 1963-64 shows that the Pacific has handled a substantial proportion of exports to Europe as well as practically all Asian exports.

Low ocean rates and the fact that Alberta is a major producer of coarse grains appear to be the chief reasons for the extent to which the Pacific shares in this European movement. Coarse grains are costly to ship in relation to their value and direct shipments, which eliminate handling charges, have been found most satisfactory. (See Table 14.)

Domestic Movement

In addition to a substantial export movement, the praries ship large tonnages of grain to eastern Canada for domestic use. Between 1959 and 1964 an average of 1.68 million tons of wheat and 1.53 million tons of coarse grains for domestic use were cleared through the Lakehead for a total of 3.21 million tons. This represents about one third of all grain shipped from the Lakehead annually during this period.

The breakdown of this movement is dealt with in detail later in this chapter. The destination of domestic grain is important in analysing Welland and Seaway tonnages and establishing a basis for forecasting future volumes.

Canadian Grain Shipments via Lakehead - 1958-64

In the six years before the Seaway opened an average of 8.63 million tons of grain was shipped by water from the Lakehead

annually. Following the opening of the Seaway the pattern of traffic altered, but the volume of traffic did not increase appreciably, averaging 8.98 million tons per year. (See Table 15.)

The change in traffic pattern, however, was evident from the first year the Seaway opened, as increasing volumes moved directly overseas from the Lakehead and direct to Lower St. Lawrence ports. By 1964 over two-thirds of all grain moving from the Lakehead was shipped through the Welland Canal to the Lower St. Lawrence and less than 30% went to Bay and Lake ports. Much of the grain now shipped to Bay and Lake ports is for domestic consumption; while it is expected that the amount shipped may drop below the 1964 figure for a time, it should increase again as domestic consumption of wheat and feed grains increases.

The tonnage of wheat moving to various lower lake destinations is shown in Table 16 for the period 1958-64 and in more detail for wheat and other grains for 1963 in Table 17. The breakdown establishes the amount of grain moving through the Welland Canal and the amount moving through the Ontario-St. Lawrence sector of the Seaway as well.

In 1963, an average Seaway year, some 9.60 million tons of grain were shipped from the Lakehead and, of this, 7.82 million tons moved through the Welland Canal, while 7.25 million tons were shipped through the Ontario-St. Lawrence sector.

In 1964, of total shipments of 12.53 million tons, 9.89 million moved through the Welland Canal and 8.9 went through the Seaway itself. This compares with total U.S. and Canadian shipments in 1964 of 17.16 million tons through the Welland and 15.51 million tons through the Montreal-

Lake Ontario sector. An estimated 7.41 million tons went direct to St. Lawrence ports. The percentage of grain moving through the Welland rose from 75.8% in 1961 to 80.1% in 1962 and 80.9% in 1963 to 84% in 1964. (See Table 18.)

Domestic Shipments of Grain

Since 1959 an annual average of 3.23 million tons of grain for domestic consumption has moved through the Lakehead terminals. Of this volume wheat has averaged 1.70 million tons, while coarse grains have averaged 1.53 million tons. This represents about 24% of all wheat shipped from the Lakehead, 77% of coarse grains and 35.5% of all shipments. Thus domestic grain is an important element of total grain tonnage. The distribution in 1964 is shown by the following table :-

Domestic Grain Movement

Welland Canal and Montreal-Lake Ontario Sector, 1964

Commodity	From Lakehead	Above Welland	Through Welland	To Lake Ontario	Through Montreal-Lake Ontario Sector
Wheat	2.2	1.0	1.2	.6	.6
Coarse grains	1.53	.76	.77	.35	.42
Total	3.73	1.76	1.97	.95	1.02

On an average, then, about seven-and-a-half million tons of Canadian grain moved through the Welland Canal, of which one-and-a-half million was for domestic use; while seven million tons transitted the Lake Ontario-St. Lawrence sector, of which one million tons was for domestic use.

PART III

UNITED STATES GRAIN AND THE ST. LAWRENCE SEAWAY

Introduction

Prior to 1959 no significant amount of grain for overseas export was loaded at U.S. Great Lake ports. With the opening of the Seaway in 1959 some 2.9 million tons of U.S. grain moved downbound through the Montreal-Lake Ontario sector of the Seaway, making up 41% of the total grain traffic. By 1962 the flow of U.S. grain had built up to 5.4 million tons and accounted for 51% of the grain traffic in that part of the Seaway. By 1964 the U.S. volume had increased to 6.2 million tons, but because of the large volume of Canadian sales to Russia it accounted for only 40% of the total grain traffic volume.

Most of the growth since 1959 has been due to the marked rise in U.S. exports during this period rather than to the ability of the U.S. Lake ports to attract a greater share of total U.S. grain exports. While total shipments have been rising, domestic shipments have declined. The future movement of U.S. grain via the St. Lawrence Seaway will be mainly determined by :-

(1) The productivity of the grain-growing sector of U.S. agriculture.

(2) The volume of U.S. grain moving to overseas markets.

(3) The cost of shipping grain by the Seaway route.

(4) Foreign aid and trade policies of the U.S. Government.

GRAIN PRODUCTION IN THE UNITED STATES

The term "grain" used in this section of the report consists of those grains included in the Canadian section (wheat, oats, barley, rye and flaxseed) and soy beans and corn, which are not produced in significant quantities in ~~western~~ Canada.

Total U.S. grain output averages about 185 million tons or seven billion bushels per year, over ten times the Canadian output. A breakdown of production is shown in the following table covering the years during which the Seaway has been open :-

Grain Production - United States, 1958-64

(millions of short tons)

	1958-62 average	1963	1964
Corn	101.9	113.6	98.5
Soy beans	18.2	21.1	21.1
Oats	18.1	15.8	14.2
Barley	10.3	9.6	9.6
Rye	.8	.8	.9
Wheat	37.9	34.6	39.0
Flax	.8	.9	.6
Total	188.0	187.4	183.9

Grain output in the United States is subject to the same general forces that affect Canadian grain production. In addition, there are two other major factors not found in Cahada which have an important bearing on the level of U.S. grain output; these are the U.S. price support activities and foreign aid programs.

Government price supports have been an important stimulus to agricultural output and government-financed foreign aid programs account for a large share of U.S. agricultural exports. While U.S. price

support programs are expected to remain stable during the next few years, agricultural surpluses remain high and will have a bearing on U.S. agricultural policy as it relates to production and exports.

The U.S. population is expected to continue its upward surge tending to reduce food products available for export, but this is not expected to affect the export volume during the forecast period covered by ths report. Technological advances should not have as great an impact on the U.S. as they will have on Canada, for, generally speaking, the U.S. farmer has advanced further in farming techniques, use of fertilizer and in mechanization. However, newer developments such as those arising from research with plant breeding, could have a similar impact upon grain crops, particularly wheat, where a breakthrough leading to hybrid wheat seems possible; this alone could increase U.S. wheat production by 10% to 20%.

ST. LAWRENCE SEAWAY TRIBUTARY AREA

U.S. Government and other agricultural economists hold varying views as to the extent of the grain producing hinterland of the Great Lakes-St. Lawrence Seaway system. For the purposes of this study an eleven-state area has been selected as being most representative; this area consists of Montana, North and South Dakota, Nebraska, Minnesota, Iowa, Wisconsin, Illinois, Michigan, Ohio and Indiana. In 1964 this area accounted for 124.1 million tons of U.S. grain production, or approximately 70% of all grain output.

An earlier study * of the output of this region plus the

*U.S. Department of Agriculture, Market Research Report No. 319

states of Wyoming, Missouri and Kansas was found to account for 80% of U.S. grain output between 1945 and 1954, 78% in 1955, 79% in 1956 and 78% again in 1957. Grain production by states for 1964 is shown in the following table :-

Total Grain Production
Leading States of Seaway Hinterland by States - 1964

	(1,000 bu.)	Millions of Tons
Montana	147,338	3.8
North Dakota	360,916	9.5
South Dakota	207,176	5.4
Nebraska	326,711	8.6
Minnesota	520,107	13.7
Iowa	993,729	26.1
Wisconsin	216,713	5.7
Indiana	472,915	12.4
Ohio	317,047	8.3
Illinois	980,449	25.8
Michigan	183,132	4.8
	4,726,233 bushels =	124.1 million tons

CHAPTER II

PATTERN OF U.S. GRAIN MOVEMENTS

A DOMESTIC MOVEMENTS

1. Pre-Seaway

Agricultural commodities accounted for twenty-six million tons in domestic waterborne commerce for the year 1957, or 3% of all cargo on a weight basis; this represents an increase of 34% over 1949. Carriage was divided as follows :-

Rivers	11.5 million tons
Coastwise	7.5 million tons
Lake	4.5 million tons

However, Lake carriage of agricultural commodities declined from 30% of the total in 1949 to 17% in 1957, due mainly to a loss of domestic traffic to railways, river barges and trucks.

Grain and grain products made up the largest part of total agricultural shipments and the grain volume handled ranged from 8.3 million tons in 1953 to 10.3 million tons in 1957. However, domestic Lake transportation of grain and grain products declined by 26% from 5.1 million tons in 1949 to 3.7 million tons in 1957. These commodities nevertheless represented 85% of the total tonnage of all agricultural commodities carried in domestic commerce on the lakes. The following table shows the decline in waterborne carriage of principal grains during the period 1949-1957 :-

Domestic Grain Shipments, Great Lakes - 1949 and 1957

'000 tons

	1949		1957		
	Volume	% of Total	Volume	% of Total	Change from 1949
heat	3,351	66	2,168	57	-35
orn	665	13	357	9	-46
arley and rye	370	7	573	15	+55
ats	180	4	138	4	-23
thers	537	10	556	15	+ 4
	5,103	100	3,792	100	-26

2. Domestic Cargo 1959-1964

Although U.S. grain exports have shown a remarkable increase via the Great ~~Lakes~~ since the Seaway opened, lake shipments of grain for domestic purposes have not increased in a corresponding manner and have yet to return to the volume of the late forties. There was a slight reversal of the downward trend during the 1959-61 period reaching a peak of 2.6 million tons in 1961, but since then there has been a further decline to 1.5 million tons in 1964. Domestic shipments represented 35% of all shipments via lake ports in 1959 and less than 20% by 1964.

These shipments, however, are only a minor factor in traffic via the Welland Canal, for the bulk of U.S. domestic or coastal trade in grain continues to move to ports about the Welland, as it did before the opening of the Seaway. The only U.S. grain that uses the Welland Canal and the Montreal-Lake Ontario sector in any significant amount is grain for export to Canada, for export after trans-shipment in Canada and for direct export. The movement of this grain is dealt with in the following table :-

Domestic and Export Movement of U.S. Grain, 1959-1964

'000 tons

Year	Total Shipments U.S. Lake ports	Domestic via Welland	Exports via Seaway	Domestic * Shipments
1959	5,464	115	3,452	2,012
1960	6,251	132.8	3,971	2,280
1961	7,107	69.1	4,536	2,671
1962	8,640	90.5	6,275	2,365
1963	8,652	65.2	6,319	2,233
1964	8,397	29.8	6,737	1,560

* Note: Domestic shipments in this case are those moving from U.S. port to U.S. port; some of this grain may, in fact, be exported via the Atlantic.

Source: U.S. Corps of Army Engineers, Great Lakes Regional Statistical Office

B EXPORT MOVEMENTS

Nearly 25% of all U.S. grain is exported every year. In 1964 this amounted to 42.5 million tons of grain which moved into the export market in the following manner :-

Exports of U.S. Grain by Export Sector, 1964

	000 bu.	Million Tons	%
Lake Ports-St. Lawrence	247,430	6.5	15.3
Atlantic	156,438	4.1	9.6
Gulf	1,048,218	27.5	64.8
Pacific	170,140	4.4	10.3
TOTAL	1,622,235 bu.	42.5	100%

Although it is not known how much of the grain produced in the Great Lakes hinterland is exported, this area accounts for over 70% of all grain produced in the U.S., while its ports handle only 15% of grain exports.

Total shipments of grain from U.S. lake ports amounted to 8.4 million tons in 1964. Overseas exports were 6.3 million tons, the balance mainly moving to ports above the Welland. The distribution of grain exports before the Seaway and during the first four years of operation is shown in the following table :-

Grain* Inspected for Export by U.S. Port Areas
1958-1962

000 tons

Port Area	1958	1959	1960	1961	1962
Great Lakes **	841	3,452	3,971	4,536	6,275
Atlantic	5,051	4,824	4,995	5,350	4,737
Gulf	10,027	11,769	13,459	18,318	20,157
Pacific	4,588	4,315	5,836	5,235	4,375
All Areas	20,507	24,760	28,261	33,439	35,544

* Wheat, corn, barley, rye, oats, flax and soy beans

** Includes shipments to Canada

Source: Market Research Report No. 621 - U.S.D.A. and Grain Market News - U.S.D.A. (Note these figures do not match Seaway traffic statistics precisely.)

In 1964 the U.S. lake ports' share of exports was 15.3%.

Thus, since 1959, the Seaway has not been able to attract a significantly larger share of total U.S. exports although it has maintained its position, while grain exports grew spectacularly by over 100% in these seven years. Because of this general increase exports via the Seaway have almost doubled and represent an increasingly important share of all tonnage on the Seaway.

Exports to Canada

Exports to Canada have grown substantially in recent years; they were .47 million tons in 1959, rising to 1.2 million tons in 1964. Although shipments to Canada via the Montreal-Lake Ontario sector have increased to some extent, the largest proportion of shipments are to ports on Lake Ontario. Export grains showing the largest increases are corn and soy beans.

Demand for corn has increased due to increased live-stock production in eastern Canada and, until domestic production can catch up, shipments of the present size are likely to continue. Soy bean shipments increased due to use of soy bean oil as well as meal. Also Canada exports soy beans to the U.K. where they can be bought more cheaply than U.S. soy beans because of empire preference; thus some of the Canadian soy bean imports really represent an indirect form of U.S. trade with the U.K. Soy Bean production is rising in Canada but is not likely to replace imported beans entirely.

Exports of U.S. grain to Canada, however, have been a fairly important part of the movement of grain via U.S. lake ports, representing from 13.7% to 27% of total U.S. exports at the lake ports. They have exceeded one million tons for the past four years, as is shown by the following data :-

U.S. Exports to Canada from Great Lake Ports

000 tons

Year	Total U.S. Exports	Exports to Canada	%
1959	3,452	473	13.7
1960	3,971	995	25.0
1961	4,536	1,246	27.3
1962	6,275	1,287	20.0
1963	6,319	1,027	16.2
1964	6,997	1,236	17.6

CHAPTER III

WELLAND and SEAWAY CANALS

TOTAL GRAIN MOVEMENT

While U.S. grain movements from Great Lake ports since the Seaway opened have increased by 55%, exports through both sections of the Seaway have doubled. The following table shows the breakdown of down-bound U.S. grain movement from 1959 to 1964 :-

U.S. Grain Shipments via Great Lakes-Seaway, 1959-1964

000 tons

Year	Total shipped above Welland	Total shipped via Welland	Total via Montreal - Lake Ontario**
1959	5,464	3,452	3,129
1960	6,251	4,036	3,309
1961	7,107	4,417	3,808
1962	8,640	6.143	5,404
1963	8,652	6,283	5,557
1964	6,997	6,897*	6,130

* Total exports less estimated 100 tons U.S. exports to Canada above Welland

** Welland shipments less shipments to Lake Ontario ports, U.S. and Canada

Source: U.S.D.A. data in bushels converted to tons

Table 21 shows how the volumes moving through these waterways are distributed. Total Welland shipments are arrived at by deducting exports to Canada above the Welland from total exports and adding U.S. domestic shipments for Lake Ontario ports. (Table 22.) The shipments via the Montreal-Lake Ontario sector represent the balance. Exports to Canada represent about 15% of traffic via the Welland Canal and 5% to 10% of Seaway Canal traffic. In total, of the 6.2 million tons shipped via the Welland in

1963, .8 million tons was destined for Canada; in 1964 the corresponding figures were 6.8 million tons and one million tons. Table 23 shows how this grain moved according to destination area. Three U.S. ports, Duluth-Superior, Chicago and Toledo account for nearly all the export movement, while an increasing amount of U.S. grain is shipped to Canada for trans-shipment overseas, direct shipping in ocean vessels has been growing steadily.

CHAPTER IV

FACTORS AFFECTING U.S. GRAIN TRAFFIC ON THE SEAWAY

The volume of U.S. grain moving into export markets in the future will be affected by a number of external and internal influences. Externally, development within the European Economic Community, world grain market conditions, world policies and the rate of world economic development, will all exert influence on U.S. grain trade abroad. Internally, U.S. agricultural and foreign aid policies will have an important bearing on U.S. grain exports generally and thus on the grain traffic moving through the St. Lawrence Seaway.

In addition, Seaway grain traffic from the U.S. will also be influenced by :-

(1) Development and modernization of Seaway port grain handling and other facilities.

(2) Cost of transportation, both inland and water.

(3) The extent to which the use of the Seaway is promoted, thereby influencing shipping patterns.

These factors are of sufficient importance to merit detailed examination as part of this report.

(1) Port Facilities

Although much has been done to improve Seaway port facilities, inadequate when the Seaway opened, much work is still necessary. Most serious have been the harbours and channels of less than the maximum 27' depth of the Seaway itself and the inadequate dock and storage facilities and cargo handling equipment.

Present grain tonnages can be handled by existing facilities at the Seaway's principal grain ports - Duluth-Superior, Milwaukee, Chicago and Toledo but improvements will be needed to handle the anticipated increased future tonnages at these ports and to provide for greater efficiency. Chicago has an elevator with a capacity of thirteen million bushels, recently constructed, whilst at Duluth-Superior there are thirteen elevators with a combined storage capacity of about seventy million bushels. These elevators are relatively old and inefficient and a new five million bushel capacity elevator with facilities for rapid loading of the largest grain vessels is under construction. The effect of this situation to date has been :-

(a) A reduction in the number of foreign flag vessels available to carry grain.

(b) Ships have been unable to take on full cargoes of grain and have had to "top off" at St. Lawrence ports due to shallow channels.

(c) High loading cost resulting from slow loading and excessive boat movement from elevator to elevator.

(2) Transportation Costs

There are three basic costs which affect the ability to develop traffic through a given port and these are :-

(a) Inland rate structures and carriers.

(b) Port terminal facilities and rate structures.

(c) Ocean steamship service and rate structures.

A fourth factor, peculiar to the ports on the Great Lakes, is the fact that deep water came to the Great Lakes, in effect, after their ports had developed trade patterns based principally on domestic customers.

Elsewhere in the world deep water ports existed first and patterns of traffic in commerce, location of cities and economic growth, etc. were condtioned by the pre-existence of such deep water ports.

Rates and Carriers

The cost of moving grain to market represents about 25% of the overseas delivery price of grain. Much of this cost is in the form of inland transportation; while these inland rail, water and truck rates represent a significant part of total transportation cost, even more significant is the effect these rates have upon the pattern of traffic destined for export. Before the Seaway opened, grain from the U.S. mid-West moved into export markets in the following manner :-

- from the Missouri River territory south by barge or rail to the Gulf ports
- western grain moved by rail to Pacific ports
- northern states area by rail to Duluth-Superior and by lake vessels from there to lower lake ports (Buffalo, Oswego, etc.) and thence by rail to Atlantic ports. Grain from this area also moved by rail direct to Atlantic ports
- central U.S. grain moved directly by rail to Atlantic ports.

Even before the Seaway, the railways had begun to lose grain traffic to trucks and barges. Rail rates doubled between 1945 and 1958 and a study* conducted in 1957 indicated grain was moving by rail at rates much above cost in the area tributary to the Seaway. (See Table 25.) This study also analysed costs and charges from selected interior

* U.S. Department of Agriculture - Market Research Report No. 319

grain-producing areas of the U.S. to three foreign destination, selected as reflecting movements of export grain for which the St. Lawrence Seaway offers a potential gateway. The ports concerned were Casablanca, Rotterdam and Santos (Brazil).

The analysis found that about 70% of all U.S. export grain in 1956 moved to countries so located that they can be served economically by the Seaway. Potential savings per bushel were as follows, based on one-way carriage by Lake-Ocean bulk carrier :-

	Origin	-	Destination	Cents per bushel savings
Wheat	Duluth	-	Rotterdam	17.23
	Duluth	-	Casablanca	17.74
	Duluth	-	Santos	20.31
	Chicago	-	Rotterdam	17.52
	Chicago	-	Casablanca	18.04
	Chicago	-	Santos	20.61

The Seaway at that time was thus believed to offer the most economical export route for grain from a broad hinterland area of the mid-West with overseas movement in Liberty ships (low surplus sale prices) or modern lake-ocean bulk carriers.

Grain movement in ocean-going vessels was found to be lower than the pre-Seaway practice of trans-shipping from "upper lake boats" at Montreal. In addition, forecast cost of moving grain by lake-ocean vessel was below the tramp or "saltie". As mentioned, it was also forecast as a result of this study that more grain would move to these ports by barge and truck.

Substantial margins existed between rail and barge costs and rates, and grain rates were expected to be reduced as a result of the Seaway as it provides deep water navigation to the grain belt. The Seaway was also expected to draw traffic from the Gulf ports due to lower costs and from the Atlantic ports. The countries include those in western Europe, the Mediterranean, Africa, Middle East, Caribbean and the eastern side of South America.

Effect of Seaway on Inland Grain Movement

Since the Seaway opened the inland transportation of grain has been characterized by intense competition, development of special equipment and the introduction of special low grain rates designed to combat the influence of the Seaway route. The railway's strenuous efforts to meet competition from other modes of transportation has, to some extent, slowed the erosion of grain rail traffic. Soon after the Seaway opened, for example, the railways began setting up their rail structures to permit the longest possible hauls. This has had the effect of damaging the Seaway's competitive position vis-à-vis the Gulf and Atlantic ports.

Initially, after the Seaway opened, many of the rate reductions were made to meet truck competition to lake ports such as Duluth and Toledo and barge traffic to Chicago and the Gulf. However, rates were also reduced on export grains shipped to Atlantic ports from specific origins east of the Mississippi River and north of the Ohio. This was the beginning of a determined bid by the railways to stem the tide of grain flowing by export routes other than the Atlantic.

There have recently been several important railway

rate changes proposed or introduced and these include :-

(1) A rate from Duluth to Buffalo of 37¢ per cwt. (22¢ per bushel). It applies only in the shipping season and is designed to make Buffalo' competitive with the Seaway. Recently, efforts have been made to extend it to the non-shipping season.

(2) The Big-John rates or minimum point-to-point service at reduced rates. Reductions of up to 60% on grain moving on southern railways lines have been offered by these railways to meet barge grain traffic. The rates apply to grain carried in a minimum shipment of 450 tons in five double sized "jumbo" covered hopper cars. Loading and unloading times have been reduced from 48 to 24 hours and direct shipment with no shopovers is required; these rates are being opposed by competing services, but are expected to be ratified in the near future.

(3) Chicago-North Atlantic trainload. This is an export rate on grain from points in the Chicago area to Atlantic export ports of 20¢ per cwt. (12¢ per bushel). This rate is proposed to draw grain from the Chicago area in competition with the Seaway. At this level those familiar with the situation expect it to have a serious effect on grain traffic through the Seaway ports.

As a result of the railway's determination to meet Seaway competition, the cost advantage of the Seaway route has been much smaller than anticipated and the grain tonnage has not developed as expected. While grain tonnages have increased steadily, most of this has been due to the dramatic rise in total grain exports between 1959 and 1964.

The situation of the Seaway in respect of U.S. grain is perhaps best illustrated by the comment of Mr. R.J. Gratzema, Vice-President of Great Lakes Overseas Inc., Chicago :- "Ton-mile rates to Great Lakes ports should be on a parity with those to tidewater ports. These rates

are currently very much out of balance. For example, the port of Chicago can only reach about 225 miles into the hinterland towards the port of New Orleans, whereas New Orleans can reach about 700 miles into the hinterland towards the port of Chicago".

Examples of discrimination that have undoubtedly reduced grain volume moving by lake ports include the case brought before the Interstate Commerce Commission by the Chicago Board of Trade alleging discrimination on the part of railroads in Illinois against Chicago, having the effect of keeping shipments of soy beans by rail, originating in central Illinois, away from Chicago. It is claimed that the defendant railroads maintain a substantially higher level of export rates on soy beans to the port of Chicago than they maintain to Gulf ports. Examples cited show the level of export soy bean rates to Chicago ranging from 138% to 190% of the level of corresponding rates to New Orleans. In dollars and cents, it costs 38¢ to ship a bushel of soy beans from Springfield 850 miles to New Orleans and it costs $26\frac{1}{2}$¢ to ship the same bushel of soy beans 211 miles from Springfield to Chicago !

The Great Lakes-St. Lawrence Seaway U.S. Senate sub-Committee hearings in 1964 produced a powerful array of forces against discriminatory action by the railways. A representative of a Toledo grain export firm summed up the current situation in his statement:- "The need of increased tonnage through the Seaway is obvious. It is also obvious that the movement of grain via the Seaway is the most efficient and economical way to move grain from this area to foreign

markets.

'Naturally, the railroads of this area have been much disturbed by the loss of the tonnage that has moved via the Seaway. The railroads are proposing much reduced export rates to the eastern seaboard but only during the period when the Seaway is open. Export grain rates from this area have always been much lower than domestic rates. To further reduce export rates during the period the Seaway is open is obviously an attempt to hurt the Seaway operations even though the railroads must suffer losses to do so. In our judgment, this is not good for the economy of our country, nor for the railroads.

'Certainly, we all want to see the railroads prosper. We do not believe, however, that making rates for the purpose of injuring the Seaway is the answer. We are confident railroads cannot carry bulk tonnage on a competitive basis with lake and ocean ships. We feel your Committee should study this proposed rate situation and do what you can to prevent rates that are primarily fixed to hurt the Seaway operation and are not in themselves profitable". *

When asked for his views as to future volume on the Seaway, the representative indicated it depended upon the railways.

"Well, the grain wouldn't move via Toledo at all. It would go directly from point of origin to the eastern seaboard. We have got a rate from Indianapolis, domestic, of 63 cents a hundred on a single car. They are proposing a rate from Indianapolis on a single car of 30 cents, export, with five days' allowance for the car to stay there. That is less than half of the domestic rate. Now, if such

* See pg. 635, Part 3, Great Lakes-St. Lawrence Seaway Senate Hearings

rates go into effect, we will have to change our whole mode of operation here". *

Another form of discrimination comes through alleged abuse of Section 22 of the Interstate Commerce Act legislation which exempts government traffic from all transportation law and regulation. It is claimed this has led to discrimination and cut-throat competition among carriers and increased transportation costs to private shippers. It places an unjust burden on taxpayers.** Similarly, the grain industry has condemned abuses under Section 22 before the Under Secretary of Agriculture (December, 1962) as reported in a study by the Toledo-Lucas County Port Authority.***

A comparison of grain rail rates in the United States has been made between 1957 and 1965 which covers rates on grain moving from selected points in the mid-West for export by lake, Gulf and west coast ports. (See Table 26.)

When compared with the 1957 rate, it appears that the rail reductions have not as yet been as extensive as one would expect after reviewing reports and statements about the rail cost situation such as those appearing in the minutes of Senate sub-Committee hearings on the Great Lakes-Seaway system. However, it will also be noted that

* Pg. 637, Part 3, Great Lakes-St. Lawrence Seaway Senate Hearings.

** Pg. 656, ibid. From a report perpared by Toledo Lucas County Port Authority.

*** Pg. 664, ibid.

increases between 1955 and 1965 have not been great and, as this was a period of rapidly rising costs, it is possible some of these 1965 rates are reductions from earlier maximums. In addition, a review of mileages reveals that while Kearney, Nebraska, for example, is considerably closer to Chicago than New Orleans, the rail rate on wheat is only $2.40 or 8% higher to New Orleans.

While not dealing to any great extent with grain, a recent study examining Chicago's potential as a foreign trade centre found that in the case of food and kindred products, "the port of Chicago is at a serious disadvantage in attemtping to clear traffic from production centres within its hinterland. Undoubtedly this situation reflects a rate-making climate that prevailed prior to the Seaway's opening when facilities for moving such traffic on the required scale were not available at the port. However, such a situation does not prevail today and Chicago must consider steps to be taken to obtain some sort of equitable treatment in a rate structure that takes into account the short haul to the port as well as the facilities". *

Nor do rates alone tell the entire story. In the case of soy bean meal, for instance, multiple car rates based on a minimum of two thousand net tons prevail between many points and New Orleans, whereas rates to Chicago are based on forty thousand pounds. This despite the fact that a major portion of production takes place much

* Draine, Edwin. "Freight Rate Structure - Export Traffic"

closer to Chicago. Recently, Chicago won a minor victory through concessions of rail rates on grain moving to Chicago from Illinois, Iowa and Missouri. (See Table 27.) These rates could be a mixed blessing, however, for, in combination with the proposed Chicago to Atlantic ports rates, they could result in a further reduction in grain rates to these eastern destinations.

Other recent developments which have a bearing on inland grain rates include the railway's proposal that carrier rates on agricultural commodities be exempt from regulation under the Interstate Commerce Commission. Rates on truck grain have always been exempt, but railroad grain rates have been regulated since the ICC was established in 1887. If this new freedom from regulation is granted, railroads undoubtedly will engage in vigorous grain rate competition and, while the grain industry would not be overly concerned with the prospect of reduced transportation costs for grain, each export area will want to be sure that the new patterns of grain rates do not discriminate against them. This is particularly true in the case of the Great Lakes where discrimination vis-à-vis other export areas is commonly alleged.

In addition, there have been a number of railway mergers in recent years in the north-eastern, south-western and mid-western United States. These mergers have been impelled by the need to modernize and rationalize to meet today's intensive climate of inter-modal transportation competition.

Significant to the Seaway is the fact that only three

railway systems will be left in the north-east (from Chicago east to the Atlantic); this will place these systems in a position to compete more intensively for grain traffic.

An offsetting development which is anticipated is the likelihood that these merged railways will be prohibited from discriminating against or among ports they serve and thus will not be allowed to set rates at levels that will divert grain from such ports as Toledo in favour of Atlantic ports. The benefit of such a ruling, if obtained, would be limited to railways serving both port areas. Thus, Chicago could not seek relief from disadvantageous rates on traffic moving to it, when the railways concerned did not serve the city or area enjoying advantage over Chicago, by reason of lower rates offered by other rail lines serving the latter city or area.

It can therefore be stated that the inland transportation scene in the United States continues to be characterized by intense competition among all transport modes and various export routes and it produces continuing fluctuations in rates and rate relationships, with the general trend downward. The other factors mentioned earlier, such as railway mergers and technological changes, are also affecting inland freight movement. The long run effect on the amount of grain moving by way of the Seaway is very difficult to predict, particularly at this time when so many changes in rail rates and costs appear imminent. However, it is observed that the railways generally continue to compete aggressively for long haul grain traffic. Since use of the Seaway as an export route generally means shorter, rather than longer, hauls this could adversely affect the volume of grain handled by the

Seaway in future.

On the other hand, if reduced transportation costs are passed on to the consumer abroad, this would mean lower grain prices and possibly larger exports. Providing the Seaway at least retains its current share of export grain tonnage, then Seaway grain traffic would rise. An attempt to reflect the effect of these various forces has been made in the range of forecasts prepared in the relevant section of the report (Part III). It is extremely difficult to estimate the effect of these many possible changes on tonnage without a more detailed study and analysis of the U.S. inland transportation situation and the inland movement of grain.

Water Transportation Service and Rates

Inadequacy of service on the lakes has been a continuing complaint since the Seaway opened. This has been particularly so for general cargo, but general cargo shipping also bears a relationship to the movement of bulk cargo, for even so-called liner service will carry grain when other cargo is lacking if the liner must sail to meet published schedules. Grain moving from upper lake ports for lower lake designations is carried in upper lake boats which previously discharged at Lake Erie ports and now move through the Seaway to Montreal, Three Rivers and Baie Commeau; this grain is trans-shipped at these points to ocean vessels for export.

Much grain, particularly from U.S. points, is also carried in full cargoes by tramp vessels (e.g. liberty ships) and ocean

liners making scheduled visits. A new type of carrier is the lake-ocean bulk carrier designed to carry ore, grain, or other bulk cargo. These ships provide serious competition to tramps and may ultimately replace them, particularly as the liberty type vessels become obsolete. Scaled down versions of these large bulk carriers are already operating in the Seaway to a limited extent.

These three types of services compete on a reasonably equal basis and the proportion each carries depends upon a number of factors: demand for shipping, levels of rates, availability of other cargoes and operating costs over a route. Generally, ocean vessels carry grain when other cargoes are not available. Seasonal variations in harvest have a considerable influence upon the damand for cargo space (although U.S. and Canadian grain surpluses available for year-round shipment in recent years has tended to reduce seasonal harvesting influence upon cargo space demand). Tramp shipping is dependent upon low cost operation and basic to profitable operation, cargoes at points where the tramp calls.

Another element tending to work against the development of shipments via the Seaway is the inadequate U.S. flag service to Great Lake ports to serve American Aid and P.-L 480 shipments which must be shipped 50% in American flag ships "to the extent such vessels are available at fair and reasonable rates by geographical area". * The

*P. L. 664 the 83rd Congress, 2nd Session, Chapter 936, Title 46, Section 1241, U.S. Code Annotated

Great Lakes has traditionally been considrered part of the "geographical area" of the Atlantic seaboard and United States vessel operators have felt little need to send vessels into the Lakes since a vessel available at an east coast port is sufficient to draw cargo from mid-West origins and away from shipment in foreign flag ships from a better-placed Lake port.

In Summary

Adequate steamship service represents a major factor in maintaining and developing a commodity movement through a port. Steamship service is increasing from the Great Lakes to the major trade areas of the world, although some areas still have limited or no service to or from the Lakes. There has been considerable reluntance on the part of U.S. flag companies to establish regular service and this, of course, has limited cargo potential. Certainly it would seem that more frequent, regular and reliable ocean services to lake ports, especially by U.S. flag carriers, are essential if the Seaway is to achieve its objectives.

3. Promotion

The lack of promotion has undoubtedly hindered growth of traffic and most of what has taken place has been done by individual port authorities, some of them new to the field; the results to date, with one or two exceptions, have been disappointing. The United States Seaway Authority itself was expected to give promotional leadership, but funds for such a program were severely restricted because the agency is financed by federal funds.

Other matters affecting the growth of the use of the Seaway include :-

(1) The eight-month season.

(2) Lack of uniform storage and other port service rates among major ports.

(3) Lack of ready availability at Atlantic ports of such shipping services and facilities as documentation, sales agents, customs, brokers, banking and other financial services.

(4) Tradition of handling shipments through Atlantic ports.

(5) Inadequacy of facilities for handling over-sized or special cargoes.

(6) The time delay of two to three days in the Seaway on shipments from an upper lake port to Europe, compared with New York.

PART IV

FUTURE GRAIN TRAFFIC THROUGH THE ST. LAWRENCE SEAWAY 1970 to 1980-85

FUTURE CANADIAN GRAIN DISPOSITION

PRODUCTION

It is anticipated that wheat and coarse grain production will increase steadily over the next fifteen to twenty years through improvements in farming techniques, plant breeding and improved plant protection.

Wheat The following changes have been taken into consideration for the purpose of estimating future wheat production to 1980 :-

	Low	Medium	High
Improved farming techniques	20%	25%	40%
Plant breeding (e.g. hybrid wheat)	10%	15%	15%
Improved plant protection	7.5%	10%	20%
Acreage reduction	-20%	-10%	-

The aggregate rise in output will probably be in the order of 42%, which is the result of working with the medium figures shown above. This includes a reduction of 10% in acreage, i.e. from twenty-nine to twenty-six million acres.

The result of such changes would be an increase in wheat production from an average 1952-65 output of 15.1 million tons to roughly 21.4 million tons with a possible high of 29.1 million tons by 1980, which is regarded as technically feasible.

Coarse Grain It is anticipated that 10.5 million additional acres will be required for coarse grains production and for hay and pasture lands by 1980. Of this, over seven million acres should be obtained from

reduction in summer fallowing with the balance from wheat acreage. About one third of the increase will likely be devoted to coarse grains output and an increase acreage of 37% has been assumed for the purpose of this forecast.

Improvements in farming techniques and plant protection methods should increase yields of coarse grains as well as wheat. It appears reasonable that a 34% increase in yield can be expected and, coupled with a 37% increase in acreage, would give a total rise in output of 83%. Production has averaged 12.3 million tons during the past twelve years and an 83% increase in this would mean production of 22.6 million tons with a possible maximum of 27 million tons.

Total grain production in western Canada by 1980 could thus rise to approximately 44 million tons, although a figure of 56 million tons is feasible.

Domestic Consumption

Canada's population is forecast to reach 30 million by 1980, a 50% increase and, allowing for declining per capita consumption, a 40% to 45% rise in domestic consumption appears realistic by that time. Because production will rise much faster than domestic needs, increasing tonnages will be available for export. The coarse grains situation is somewhat different since consumption is expected to rise in line with rising output, leaving very little additional grain available for export. In addition, most of the increase in use will be on the prairies and eastbound shipments of coarse grains for domestic use will not increase greatly. Domestic use of wheat is expected to increase to

five million tons by 1970,* 6.8 million tons by 1980 and 7.7 million tons by 1985.

By 1970 about 15.4 million tons of western coarse grains will be consumed in Canada - 13.74 million tons in the west and the balance in the east. By 1980 western use will be 18 million tons and eastern 1.8 million tons for a total of nearly 20 million tons; the latter figure represents a 65% rise in domestic consumption.

Exports Canada has exported an annual average of 10.1 million tons of wheat and 1.3 million tons of coarse grains since the St. Lawrence Seaway was opened in 1959. Total export tonnage by 1970 has been forecast at 14.2 million tons - 12.12 million tons of wheat and 2.07 million tons of coarse grains.

Correspondingly, increases in exports buoyed up by world demands are anticipated for 1980. Wheat exports by this time should be 14.45 million tons and coarse grains 2.78 million tons for a total tonnage of 17.23 million tons. Because both the major export routes tend to dominate the movement of grain to certain market areas the location of the markets and the growth in demand for Canadian grain in these areas in the future is equally important.

Europe The formation of the European Economic Community (EEC) is of major significance to Canada's export grain sales, for one of the Community's aims is to become more self-sufficient in agriculture; this market represents 16% of all Canadian agricultural exports. Canada's

* This is in contrast to U.S. Department of Agriculture estimates of 6.6 million tons Canadian domestic consumption by 1970.

grain sales declined in 1962-63 following formation of the EEC, but increased again in 1963-64 to the levels of 1961-62.

Studies indicate an EEC market of ten million tons of cereal grains (much of it high protein hard wheat) after 1970 and while "direct demand for cereal products is expected to level off, Canadian durum and bread wheats should continue to occupy a special position". *

Feed grains for beef and poultry will be in demand as will oil seed, on which there is no import levy. Canada has sold about 1.8 million tons of wheat in each of the past six years and increasing amounts will be needed for blending domestic wheat as more soft wheat is grown. Based on a rising ratio of Canadian wheat to total wheat consumed of 8% to 9.9% between 1959 and 1961, exports are expected to reach 2.2 million tons by 1970, 2.5 million tons by 1975 and 2.5 million tons by 1980.

Canadian durum exports should continue while Canada's share of barley and oats should increase if quality is improved and supplies are available; flaxseed sales should also expand despite strong U.S. competition. For the balance of western Europe, sales are expected to continue to increase under protection through long-term agreements and the stimulation of increasing populations. Sales to this area, largely Great Britain, appear relatively promising, for Canadian wheat is well established and accepted. This market should expand to 3.3 million tons by 1970 and 3.75 million tons by 1980.

* Common Agricultural Policy of the EEC and its Implications for Canada's Export. Sol Sinclair.

Eastern Europe should also expand its imports of Canadian grain because these countries like Canada's credit terms and the fact that long-term commitments have been met even in periods of short supply. Most of these sales are on a long-term agreement basis and there has been no indication that Canada cannot continue to anticipate good sales. It is extremely difficult to forecast tonnages but, excluding major Russian purchases, sales of 1.2 million tons are expected in 1970 rising to 1.5 million tons by 1980. This should place total European sales in 1970 at 6.7 million tons of wheat, with a further 1.09 million tons of coarse grains, for a total of 7.79 million tons. By 1980 total grain shipments should be 8.93 million tons, 7.6 million tons of wheat and the balance in coarse grains.

<u>Asia</u> The other major market area is Asia. There, Japan accounts for the bulk of the market and, while competition is increasing, Canada should hold her share of this rising market. China is a promising market, but long-term Australian competition will be an important factor. Despite this, China took up the 187 million bushels of wheat contracted for over a three-year period in two years and, with a rapidly rising population, is expected to be a major importer of wheat for many years to come.

The Phillipines has also be come a good customer for Canadian grain, replacing India and Pakistan where the U.S. Foreigr Aid sales have taken over and reduced Canada's sales from 500,00 tons to only 50,000 tons per year. With growing populations and through expanded aid, Canada could regain some of this market.

Middle East and Africa

The Canadian Wheat Board is making a determined effort to develop these markets. The potential tonnage is small but continuing sales effort, backed by assistance in financing, could create long-term demands for Canadian hard wheat, developed in the face of substantial U.S. sales under its various aid programs. A market for 100,000 tons by 1970 and 200,000 by 1980-85 appears realistic.

South America Faced with the highest rate of population increase in the world, South America will be a net food importer in the future and an estimated ten million tons will be imported annually by 1980. Venezuela and Ecuador offer the greatest potential for Canadian wheat and total sales should rise from the current two-thirds of a million tons to one million tons by 1970 and one-and-a-half million tons by 1980.

CHAPTER II

FUTURE COST OF CANADIAN GRAIN MOVEMENTS

Canadian grain transportation costs are relatively low and generally stable, although some upward pressure has recently developed and handling costs will probably show a slow rise over the next twenty years, partly because many facilities are becoming obsolete. Rail rates are fixed by statute and should not rise. However, much depends on the final outcome of the rationalization of the grain handling and moving system of the prairies, for which the railway line abandonment issue will probably provide the incentive.

The other main factor in transportation costs is ocean rates, since these tend to be somewhat volatile and could play an important part in determining the volume of grain moving in each direction. Although it is impossible to predict what ocean rates will do over the next five and fifteen-to-twenty year periods, certain probabilties can be discussed.

The Pacific route is a much longer ocean route and cargo volume is much more vulnerable to rises in ocean rates. Ever since the Korean War, there has been a surplus of shipping out of Pacific ports which has produced declining rates. It will be a considerable time before this position is rectified, although there were indications in 1964 that an improvement had finally begun. Ocean rates have been depressed generally and especially so in the Pacific, and upward pressure can be expected vis-à-vis the Atlantic and particularly Seaway port areas. Offsetting this will be economics of larger scale shipping, but to a considerable extent this benefit will accrue to the Seaway as well.

Thus it would seem that, based on costs, the Pacific's ability to compete for European traffic will be somewhat reduced and these markets will be supplied by grain moving eastward. Contributing to this will be the fact that rising volumes of Asian-bound grain will be available to replace any decline in shipments to Europe from the Pacific ports.

CHAPTER III

MOVEMENT OF CANADIAN GRAIN FROM PRAIRIES

1970: Wheat

The export projections indicate that by 1970, of a total export market of 12.1 million tons of wheat, 6.8 million tons will move to European and Middle East markets. It is probably that about 5.6 million tons will continue to move through the Lakehead en route to these markets abroad. In addition, approximately .6 million tons should move to other markets (Africa, South America, etc.) for a total of 6.2 million tons, compared to the 5.4 million ton average of 1959-64 period. The balance of the export increase of 1.2 million tons will go through the Pacific for a total of close to 5.3 million tons, while Churchill will remain roughly the same at about .6 million tons.

In addition to exports, eastern shipments of wheat for domestic purposes should rise from the 1959-64 average of 1.7 million tons to 2.1 million tons in 1970. A total eastbound movement through the Lakehead of 8.3 million tons of wheat may be expected by 1970 compared with an average 7.1 million tons in the 1959-64 period.

Coarse Grains

The coarse grain export movement should be about 2 million tons in 1970. In view of rising markets in Asia and the ability of Pacific-routed coarse grain to reach its European markets, the Pacific will retain its dominant position in the handling of export coarse grains, rising from .84 million tons to 1.2 million tons in 1970. Eastern export movement is forecast to rise somewhat more slowly from .43 to .8 million tons.

1980-85: Wheat

It is expected that by 1980-85 the trends established in the late '60s and early '70s will be firmly established. Continuing strong demand abroad for Canadian wheat is anticipated, resulting in expanding Canadian output. While it is likely that there will be a similar demand for coarse grains, the Canadian farmer is not expected to produce sufficient coarse grains to meet this demand entirely, in view of the parallel demand for wheat. Rising output of corn in Ontario, however, will reduce eastern consumption of western feed grains and likely have the effect of encouraging greater exports.

Table 28 illustrates the Canadian figures relative to the expected production, consumption and export disposition of grain during the period 1970-85.

CHAPTER IV

IMPACT OF VARIABLE FACTORS UPON CANADIAN GRAIN MOVEMENTS

Production and export demand are the key variables in establishing grain movement of wheat, while for coarse grains, production and domestic consumption are the chief determinants in the amount of grain being moved. To these must be added the location of the export markets and the comparative costs of moving the grain to these markets.

Production

Perhaps the most variable factor is grain output itself. Wheat production is forecast at 18 million tons by 1970 and 21.4 million tons by 1980. Production at either of these periods could range widely to a high of perhaps 24 million tons in 1970 and 29 million tons in 1980, the latter two figures being regarded as technically feasible.

For coarse grains the variations are to a high of 21 million tons in 1970 and 27 million tons in 1980.

Markets

The superior baking quality of Canadian hard wheat would seem to assure Canada of a fairly substantial base market for this commodity. Barring a major depression, this market should not go below 9 million tons annually, for there are many countries which depend upon Canadian wheat to improve the baking quality of the flour produced from domestic or imported soft wheats.

Canada's maximum market potential would seem to be

limited only by the quantity of grain available for export and the ability of the importing countries to pay for it. Recent evidence of Canada's willingness to extend financing assistance to promote sales of grain, if continued, will undoubtedly help sales abroad. If Canada is prepared to increase imports from her major grain customers as has been indicated recently this, too, will aid grain sales. Special mention is made below of the recent wheat sale to Russia and the impact this, and any similar sales, could have on future Canadian wheat exports and, of course, on future grain traffic tonnages on the Seaway.

Russian Wheat Sale

The recent success that the Canadian Wheat Board has enjoyed in sales of grain, especially wheat, to Russian and other Communist areas, brings a new dimension to the forecast of potential Seaway grain traffic.

When the first major Russian sale was made in 1963 it was not expected to be repeated in anything approaching this scale. However, Russia's second poor crop in three years leads to a closer examination of Russia's position as a future grain customer, which can be summarized as follows :-

- Russia's population is increasing
- concurrently, farm output is declining due to poor farm management and to expansion of grain grain production in relatively dry areas which have not proven successful in recent years
- Russia has assumed increasing responsibility to provide grain to satellite countries which have also encountered production problems and drought. This applies particularly to Cuba, but also to some

eastern European countries with which Russia trades. Thus Russia needs grain for this purpose.

- Russia's determination to raise the standard of living of her people.

Russia is not only buying for today, but also to ensure adequate reserves in anticipation of growing demand and unstable internal supply.

Canada's success in making wheat sales abroad is shown by the 18 million ton market achieved in 1965-66 crop year. This is above the 16 million ton figure reached in 1963-64 and well in excess of the forecast export movement of about 14 million tons by 1970. However, Board officials point out that this year Canada had a bumper crop due to good rainfall, while Russian and, in fact, many other areas, had severe drought. Canada had the grain to sell, while production was down elsewhere and this has resulted in record exports. Next year, officials say, we could have a small crop and experience difficulty in meeting our long-term contract commitments.

Nevertheless, the previous examination of long-term export demand and the current purchase, plus the heavy purchases by China indicate that, without highly favourable conditions, the production levels that many countries, especially Communist, have achieved, are inadequate to meet their needs. It might further be anticipated that population increases will largely offset future gains resulting from better production methods, etc.

Similarly, Canadian grain production prospects appear promising and the combination of rising supply and increasing demand could mean substantially heavier exports by 1970 than had been forecast

earlier. By 1970 it had been anticipated that Canadian grain export sales would be 14.2 million tons, but in 1963-64 total exports were 18 million tons and in 1965-66 the same experts expect them to exceed that figure for wheat alone.

It is impossible to predict whether such sales will be made in the future and, if so, when, but their recurrence on an irregular but periodic basis cannot be discounted and could raise the long range export forecast by as much as 35%.

The possible upper and lower limits to the forecasts have been worked out and are shown in Tables 28 and 34. These extremes cover most conceivable contigencies and neither is likely to happen. The confidence in the forecasts can be expressed by stating the range that would, in the judgment of the authors of this study, have a 90% likelihood of covering actual developments. This range is in the order of plus or minus 15% of the mean forecast. The Table below shows the confidence range for forecast Canadian grain traffic.

FORECAST RANGE SEAWAY TRAFFIC - CANADIAN GRAIN. 1970 TO 1985

	1970	1980	1985
Welland Canal			
Minimum	8.2	9.7	10.1
Mean	9.6	11.4	11.9
Maximum	11.0	13.1	13.7
St. Lawrence Seaway sector			
Minimum	7.5	8.6	9.1
Mean	8.9	10.3	10.9
Maximum	10.3	12.0	12.7

Tables 28-32 provide complete details of expected Lake shipments of Canadian grain for the years 1970-1985.

CHAPTER V

UNITED STATES GRAIN SHIPMENTS

The Seaway's share of total U.S. grain exports has remained at between 15% and 18% and most of the Seaway's growth in export grain traffic has been due to the general increase in U.S. grain exports abroad in recent years. Total U.S. grain exports are expected to rise by about 25% between 1963 and 1970 (36 to 45 million tons) and, assuming the Seaway achieves a 20% share of exports by that period, then total Seaway shipments will rise to 9 million tons.

The total movement of U.S. grain through the St. Lawrence sector by 1970 is forecast at 8 million tons and slightly higher at 8.4 million tons through the Welland. Exports abroad are expected to be 7.75 million tons and, to Canada, .75 million tons. *

United States grain exports are expected to increase 30% and reach 60 million tons by 1980. A 20% share in this tonnage would result in a Seaway movement of 12 million tons. By 1980 it is estimated that 10.8 million tons will transit the Seaway sector and 11.3 the Welland.

The forecast movement for 1985 is based on an assumed share of total grain exports of about 22.5% which would yield total exports of 12.9 million tons, of which the Welland would carry 12.8 million tons. The St. Lawrence sector is forecast to handle 12.3 million tons by 1985 after an allowance of .5 million tons for delivery to Canada at Lake Ontario ports.

* Exports to Canada will not increase as fast as U.S. exports generally due to increased Canadian production of corn and soy beans. Deliveries should be: .1 million tons above the Welland, .4 at Lake Ontario ports and .25 at St. Lawrence ports.

Assuming Canada continues to import about one million tons of U.S. grain annually, about 12 million tons of U.S. grain would be transported through the St. Lawrence sector for export abroad. The projected increase in the Seaway share of U.S. export grain from an average of 17% to 20% by 1970 appears justified in the light of :-

(1) Current strenuous efforts to improve inland rates of grain moving to lake ports.

(2) Preponderance of U.S. grain production in Great Lakes hinterland.

(3) Efforts by port authorities to improve facilities, lower handling and other costs, and the Seaway's competitive position.

(4) Continuing importance of Northern Europe as a wheat-importing area.

(5) Increasing demand from this area for corn and coarse grains including oil seeds.

The forecasts of U.S. grain tonnage that have been made are, of necessity, very approximate. The minimum forecast for 1970 is based on the assumption that U.S. grain exports will remain at about 40 million tons and that the implementation of low trainload rates from Chicago area to the Atlantic will reduce the Seaway's share of traffic to 14%. Canadian exports are assumed to be slightly lower than the mean.

The maximum forecast for 1970 is based on assumed grain exports of 50 million tons and a Seaway share of 20%.

For 1980, minimum total exports are estimated at 57.5 million tons and the Seaway sector's share 15%, for a total of 6.5 million tons. Maximum Seaway tonnage is estimated at 13.5 million tons based on exports of 65 million tons and a 22% Seaway share. After deducting Canadian deliveries, the 1985 maximum movement would be 16.6

million tons, whilst minimum export tonnage in that year is estimated at 9 million tons, based on a 50 million tons export forecast and an 18% share by the Seaway.

As in the case with Canadian grain traffic the extremes as shown in Table 34 represent rather unlikely developments. For practical purposes the "judgment confidence" in the forecasts is that the chances are nine out of ten that actual developments will fall within plus or minus 15%. The main difference with the U.S. grain traffic is that it is possible (although considered fairly unlikely) that much more could be diverted to the Seaway route.

Tables 33-34 provide complete details of expected Lake shipments of United States grain.

APPENDIX

EFFECT OF RUSSIAN WHEAT SALE ON 1965-66 FORECAST

RUSSIAN WHEAT MOVEMENT, 1965-66

The entire sale of 5.05 million tons of wheat to Russia announced August 12th, 1965, will be shipped from the Lakehead either direct via lakers to Lower St. Lawrence ports, or to Bay ports and thence by rail to the Atlantic ports.

By agreement the contract between the Canadian Wheat Board and the U.S.S.R., covering the sale and purchase of 5,060,000 short tons, 5% more or less, of Canadian wheat provides as follows :-

DELIVERY AND SHIPMENT

Date	Ex St. Lawrence River Ports	Ex Canadian Atlantic Coast Ports	
	short tons	short tons	
1965			
August	110,000		
September	495,000	110,000	
October	715,000	110,000	
November	715,000	110,000	
December	165,000	110,000	
	2,200,000	440,000	
1966			
January		137,500	
February		137,500	
March		137,500	
April		137,500	
May	957,000		
June	880,000		
July	33,000		
	4,070,000	990,000	5,060,000

Of the total sale moving via the St. Lawrence River and Atlantic ports of 5,060,000 short tons (plus or minus 5%), the total tonnage range is from 4.5 to 5.5 million tons. Using an average of 5 million tons the contract calls for movement of 2.2 million tons from St. Lawrence River ports before freeze-up this year, with a further 440,000 tons to be shipped from Atlantic Coast ports. Of the quantities scheduled for delivery from Atlantic ports in the months of September through December, the Board has the option to deliver any or all of this from St. Lawrence River ports. Similarly, the 137,500 tons of wheat scheduled for shipment from the Atlantic in April of 1966 can also be delivered from St. Lawrence River ports.

It will be readily noted that there are a number of variables in this movement and an attempt has been made to analyse their effect. In doing so, it is assumed that the adjustment, 5% up or down, will apply at the end of the total shipment and therefore will not have a bearing on 1965 movement.

Movement via the Seaway could range from as low as 2.2 million tons to as much as 3.6 million tons. A total of 3.5 million tons could be reached if all scheduled shipments ex St. Lawrence River ports were met, plus a further movement of the full amount of Atlantic port shipments, togther with a movement of the 950,000 tons of grain scheduled for shipment in May, 1966. The total could be further increased to 3.6 million tons if the scheduled April Atlantic port shipment were also transferred to St. Lawrence River ports; this grain would have to be in store in the Lower St. Lawrence ready to move in 1966.

The following is an outline of the anticipated effect of the Russian sale upon the movement of grain down the Seaway for domestic and export purposes :-

REVISED FORECAST - GRAIN MOVEMENT - ST. LAWRENCE SECTOR

1965	Millions of short tons		
	Original Forecast	Russian Shipments	Revised Forecast
Minimum forecast	6.1	2.2	8.3
Maximum forecast	6.1	3.7*	9.7
1966			
Minimum forecast	6.2	.91**	7.11
Maximum forecast	6.2	2.0***	8.2

* 2.2 + .95 for May, 1966, shipment (+.440 + 137,500) Atlantic movement
** June and July, 1966, shipment only
*** May, June, July shipment + April Atlantic shipments

REVIEW OF EXPORT FORECAST via SEAWAY - WHEAT, 1965

			Millions of Tons
Total exports via Seaway			5.351
To Europe :	E.E.C.	1.9	
	Other west	2.9	
	Eastern	.9	
Total Europe		5.7	
Seaway share		85%	
Seaway movement			4.8
Other areas:	Africa	.2	
	Western hemisphere	.5	
	Asia	3.0	
	Other	.3	
Total		4.0	
Seaway share		15%	
Seaway movement			.6
Total Seaway forecast			5.4

STATISTICAL TABLES

TABLE 1

REGIONAL AND WORLD POPULATION
Actual 1900 - 1960, Porjected 1960 - 2000
(Millions)

Region	1900	1910[1]	1920[2]	1930[2]	1940[2]	1950	1960	1970	1980	1990	2000
North America	81	99	117	135	146	168	197	225	254	283	312
Latin America	63	76	90	109	131	163	206	265	348	455	592
Western Europe[3]	205	220	236	258	279	278	300	321	352	388	421
E. Europe & USSR[3]	219	234	250	273	297	296	339	390	440	483	526
Africa	120	130	140	155	172	199	235	278	333	410	517
Asia	857	914	970	1, 047	1, 176	1, 380	1, 620	1, 980	2, 470	3, 090	3, 870
Oceania	6	7	9	10	11	13	16	19	22	26	29
TOTALS	1, 551	1, 680	1, 812	1, 987	2, 212	2, 497	2, 913	3, 478	4, 219	5, 235	6, 267

1) Figures for this year were not included in the original source but were arrived at by interpolation.
2) Figures for these years were taken from D. Groenveld, Investment for Food, 1961, p. 107.
3) For some years, figures were available only for "Europe" as a whole in which case the breakdowns between Eastern and Western Europe are estimates based on years for which separate data are available.

Source: United Nations: The Future Growth of World Population, 1958 (57)

TABLE 2

CANADIAN GRAIN PRODUCTION
EXPORTS & DOMESTIC CONSUMPTION
1952 - 1964
(Millions of Short Tons)

Year	Oats	Barley	Rye	Flax	Total Coarse Grain	Wheat	Total All Grain
1963 - 64							
Production	7.2	5.3	0.4	0.6	13.5	21.7	35.2
Exports	0.3	1.1	0.2	0.4	2.0	17.8	19.8
Domestic use	6.5	3.5	0.1	0.1	10.2	4.7	14.9
1962 - 63							
Production	7.9	4.0	0.4	0.4	12.7	17.0	29.7
Exports	0.3	0.4	0.2	0.4	1.3	9.9	11.2
Domestic use	6.4	2.9	0.1	0.1	9.5	4.1	13.6
1961 - 62							
Production	4.5	2.7	0.2	0.4	7.8	8.5	16.3
Exports	0.1	1.0	0.1	0.3	1.5	10.7	12.2
Domestic use	5.2	3.0	0.2	0.1	8.5	4.3	12.8
1960 - 61							
Production	6.4	4.6	0.3	0.6	11.9	15.6	27.5
Exports	*	1.1	0.1	0.4	1.6	10.6	12.2
Domestic use	6.1	3.9	0.2	0.2	10.4	4.7	15.1
1959 - 60							
Production	5.5	5.2	0.2	0.5	11.4	13.4	24.8
Exports	0.1	1.5	0.1	0.3	2.0	8.3	10.3
Domestic use	5.9	3.7	0.2	0.2	10.0	4.7	14.7
1952/3 - 1958/9							
Av. Production	6.2	5.8	0.4	0.5	12.9	15.0	27.9
Av. Exports	0.5	2.0	0.2	0.3	3.0	8.9	11.9
Av. Domestic use	5.7	3.6	0.2	0.2	9.7	4.7	14.4

* Less than 50,000 tons.

Source: Grain Trade of Canada (Converted to weight basis.)

TABLE 3

CANADIAN EXPORTS OF WHEAT BY DESTINATION
Crop Years: 1958-59 to 1963-64
'000 Tons

	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
West Europe (EEC)						
Germany	1,060	753	999	1,331	848	1,129
Belgium	323	324	368	347	302	469
Italy	33	65	349	117	148	117
Other EEC	276	401	615	141	354	246
TOTAL EEC	1,692	1,543	2,331	1,936	1,652	1,961
Other West Europe						
Britain	2,634	2,420	2,384	2,233	2,348	2,392
TOTAL West Europe	3,300	3,010	2,907	2,762	2,735	2,875
Eastern Europe						
Poland	163	147	172	372	429	508
Czech	-	-	361	-	133	868
Russia	221	-	227	-	-	3,413
TOTAL	384	147	899	669	681	7,499
Africa						
South Africa	231	203	-	15	239	91
TOTAL	242	281	28	107	276	116
Western Hemisphere						
United States	102	63	76	44	35	31
Venezuela	87	106	80	143	202	239
Ecuador	34	40	36	35	36	33
Sub-total	223	209	192	222	273	303
TOTAL	288	313	278	289	351	619
Middle East						
TOTAL	49	144	48	41	73	72
Asia						
Japan	1,240	1,384	1,636	1,452	1,336	1,506
China	14	-	1,051	2,181	1,710	1,251
Phillipines	35	44	29	116	204	221
India	344	144	119	107	21	22
Sub-total	1,633	1,572	2,835	3,856	3,271	3,000
TOTAL	1,757	1,653	2,932	3,946	3,308	3,076

Source: Canadian Grain Exports.

TABLE 4

SUMMARY OF CANADIAN WHEAT AND FLOUR EXPORTS (MILLION BUSHELS)

	1951-62	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62	1962-63	1963-64
TOTAL WHEAT & FLOUR EXPORTS	355.8	385.5	255.1	251.9	312.3	264.4	320.3	294.5	277.3	353.4	357.9	332.1	594.1
of which Flour	51.1	56.5	46.3	40.6	40.0	33.5	40.4	37.1	37.0	35.9	31.9	27.6	54.4
Wheat	304.7	329.0	208.8	211.3	272.3	230.9	279.9	257.4	240.3	317.5	326.0	300.1	539.7
GOVERNMENT ASSISTED													
1) Colombo Plan													
Regular		6.7	2.2	0.2	0.3	1.2	6.2	2.4	7.6	7.3	6.5	1.3	2.5
Long Term Loans							14.9	6.6					
Special Gifts							9.0	8.2					
2) U.N.R.W.A.						0.2	1.0	1.0	0.5	1.1	0.8	0.5	0.3
3) E.C.I.C.		5.5	7.7	3.6	26.2	9.5	2.9	5.4	4.9	17.8	12.3	22.5	30.6
4) N.A.T.O. Flour										2.4			
5) Chile (Relief)									0.5				
6) China (credit only)										7.9	81.5	56.4	45.0
TOTAL ASSISTED		12.2	9.9	3.8	26.5	10.9	34.0	23.6	13.5	35.8	101.1	80.7	78.4
of which Wheat		12.2	9.9	3.6	26.2	10.4	30.4	20.4	11.4	31.4	99.4	80.0	76.8*
Flour				0.2	0.3	0.5	3.6	3.2	2.1	4.4	1.7	0.7	1.6
COMMERCIAL													
Wheat	304.7	316.8	198.9	207.7	243.0	217.9	245.3	231.7	223.3	279.5	223.4	220.1	459.[illegible]
Flour	51.1	56.5	46.3	40.4	39.7	33.0	36.8	33.9	34.9	31.5	30.2	26.9	52.8
Seed Wheat					3.1	2.6	4.2	5.3	5.6	6.6	3.2	4.4	3.0
TOTAL COMMERCIAL	355.8	373.3	245.2	248.1	285.8	253.5	286.3	270.9	263.8	317.6	256.8	251.4	519.7

Source:
Grain Division, Department of Trade and Commerce, Ottawa. September 21st, 1964.

* In addition 38,500 bushels wheat equivalent of flour were exported under the World Food Program.

TABLE 5

ESTIMATED AVERAGE COST OF GRAIN SHIPMENTS MID-PRAIRIE TO GREAT BRITAIN BY EXPORT ROUTE, 1957-58 to 1963-64

cents per bushel

Crop Year	Pacific	Churchill	St. Lawrence	Atlantic	Lakehead Direct
1957-58	45.3	42.6	55.0	60.0	-
1958-59	46.1	41.2	52.3	60.7	51.8
1959-60	46.2	41.0	53.2	61.1	52.8
1960-61	44.6	41.5	54.1	62.5	52.8
1961-62	47.2	45.6	55.2	62.6	55.3
1962-63	46.6	42.0	52.0	62.0	50.9
1963-64	55.0	46.1	56.0	66.6	55.7
COST OF INTERIOR MOVEMENT TO OCEAN PORT					
1957-58	21.0	22.2	38.5	44.6	-
1958-59	21.0	22.2	36.2	44.5	20.9
1959-60	21.0	22.2	35.7	44.1	20.9
1960-61	21.0	22.2	35.6	44.2	21.0
1961-62	21.0	22.2	35.6	44.7	21.0
1962-63	21.8	22.9	33.5	44.4	21.8
1963-64	21.3	22.8	34.0	44.0	21.3
AVERAGE OCEAN FREIGHT COSTS					
1957-58	24.3	20.4	16.5	15.4	-
1958-59	25.0	19.0	16.1	16.0	30.8
1959-60	25.1	18.8	17.4	17.0	31.9
1960-61	23.6	19.2	18.5	18.2	31.7
1961-62	26.2	23.4	19.6	17.8	34.3
1962-63	24.8	19.1	18.5	17.6	29.1
1963-64	33.7	23.7	22.9	22.6	34.4

Source: Canadian Grain Exports 1957-58 to 1963-64.

Board of Grain Commissioners

TABLE 6

COMPARISON OF TRANSPORTATION COSTS TO GREAT BRITAIN
SEAWAY U.S. PACIFIC
1963 - 64 (in ¢ per bushel)

	SEAWAY						PACIFIC				
				Water							
PLACE	Handling	Fobbing	Rail	Lake	Ocean	Total	Handling	Fobbing	Rail	Water	Total
Winnipeg	4.5	2.844 .390	8.4	11.503	22.974	51.610	-	-	-	-	-
Souris	4.5	2.844 .390	10.2	11.503	22.974	53.411	-	-	-	-	-
Dauphin	4.5	2.844 .390	10.8	11.503	22.974	54.011	-	-	-	-	-
Regina	4.5	3.234	12.0	11.503	22.974	55.211	-	-	-	-	-
Lanigan	4.5	3.234	12.6	11.503	22.974	54.811	4.5	2.984	17.4	33.759	58.643
Saskatoon	4.5	3.234	13.2	11.503	22.974	55.411	4.5	2.984	14.4	33.759	55.693
Biggar	4.5	3.234	13.8	11.503	22.974	56.011	4.5	2.984	14.4	33.759	55.693
Prince Albert	4.5	3.234	13.8	11.503	22.974	56.011	4.5	2.984	14.4	33.759	55.693
Maple Creek	4.5	3.234	13.8	11.503	22.974	56.011	4.5	2.984	13.8	33.759	55.233
Lethbridge	4.5	3.234	13.8	11.503	22.974	56.011	4.5	2.984	13.2	33.759	54.633

Source:

TABLE 7

GRAIN PRODUCTION[1] SEAWAY AND PACIFIC HINTERLAND
Crop Year 1962-63

(Millions of Short Tons)

	WHEAT	COARSE GRAIN	TOTAL
Manitoba	1.66	.89	2.55
Eastern Saskatchewan[2]	5.12	.68	5.80
Totals	6.78	1.57	8.35
Western Saskatchewan[3]	2.92	.29	3.21
Alberta	2.30	.87	3.17
B.C.	.06	.08	.14
Totals	5.28	1.24	6.52
	Total Tonnage		14.87
	Percent Seaway Hinterland		56%
	Percent Pacific Hinterland		44%

Source: Grain Trade of Canada

(1) Shipments Data Used

(2) Crop Districts: 1A, 1B, 2A, 2B, 3AN, 3AS, 5A, 5B, 6A, 8A, 8B

(3) Crop Districts: 3BS, 3BN, 4A, 4B, 7A, 7B, 9A, 9B, 6B

TABLE 8

GRAIN PRODUCTION [1] SEAWAY & PACIFIC HINTERLAND
Crop Year 1963 - 64
(Millions of Short Tons)

	WHEAT	COARSE GRAINS	TOTAL
Manitoba	1.77	.69	2.46
Eastern Saskatchewan [2]	7.61	.35	7.96
Totals	9.38	1.04	10.42
Western Saskatchewan [3]	4.91	.26	5.17
Alberta	3.89	1.66	5.55
Totals	8.80	1.92	10.72
	Total Tonnage		21.24
	Percent Seaway Hinterland		49.0%
	Percent Pacific Hinterland		51.0%

Source: Grain Trade of Canada.

1) Based on Shipments.

2) Crop Districts: 1A, 1B, 2A, 2B, 3AN, 3AS, 5A, 5B, 6A, 8A, 8B.

3) Crop Districts: 3BS, 3BN, 4A, 4B, 7A, 9A, 9B, 3BS, 3BN, 6B.

TABLE 9

MOVEMENT OF GRAIN FROM PRAIRIES BY PRINCIPAL SECTORS
1958 - 1964
'000 Short Tons

	PACIFIC				LAKEHEAD				
Year	Wheat	Coarse Grain	Total	%	Wheat	Coarse Grain	Total	%	TOTAL *
1958	3, 321	932	4, 253	31. 7	5, 817	2, 831	8, 648	64. 5	13, 399
1959	3, 323	1, 169	4, 392	34. 1	5, 670	2, 155	7, 825	60. 7	12, 879
1960	2, 996	802	3, 798	31. 4	5, 590	2, 080	7, 670	63. 4	12, 062
1961	4, 269	1, 019	5, 288	35. 0	7, 387	1, 824	9, 211	61. 0	15, 085
1962	4, 254	465	4, 719	38. 2	5, 542	1, 458	7, 000	56. 6	12, 365
1963	4, 896	590	5, 486	34. 6	7, 619	2, 022	9, 641	60. 9	15, 820
1964	5, 200	1, 074	6, 274	32. 2	10, 585	1, 953	12, 538	64. 4	19, 468
Average 1959-1964	4, 139	848	4, 987	35. 7	7, 065	1, 915	8, 970	64. 3	13, 957

Source: Board of Grain Commissioners - Grain Reports.
Dominion Bureau of Statistics.

* Includes grain moved to the Port of Churchill

TABLE 10

CANADIAN GRAIN EXPORT SHIPMENTS
Calendar Years: 1958 - 1964
By Seaboard Sector
'000 Tons

Year	Pacific	%	St. Lawrence	%	Lakehead Direct	%	Churchill	%	Atlantic	%	Total
1958	4, 253	42. 5	4, 384	43. 8	17	0. 17	598	6. 0	766*	7. 6	10, 017
1959	4, 392	46. 8	3, 130	33. 3	450	4. 8	662	7. 0	764*	8. 1	9, 398
1960	3, 798	45. 6	2, 771	33. 3	560	6. 7	594	7. 1	604*	7. 3	8, 327
1961	5, 288	44. 5	4, 637	39. 0	420	3. 5	586	4. 9	968*	8. 1	11, 899
1962	4, 719	48. 1	3, 362	34. 2	413	4. 2	646	6. 6	670	6. 8	9, 810
1963	5, 486	41. 0	5, 594	41. 8	521	3. 9	693	5. 1	1, 067	7. 9	13, 361
1964	6, 274	39. 7	7, 431	46. 6	434	2. 7	656	4. 1	1, 142	7. 1	15, 937

* - D. B. S. Shipping Statistics

Source: Canadian Grain Exports and Special Study, Board of Grain Commissioners.

TABLE 11

CANADIAN WHEAT EXPORTS BY SEABOARD SECTOR
Calendar Years: 1958 - 1964
'000 Tons

Year	Pacific	%	St. Lawrence	%	Lakehead Direct	%	Churchill	%	Atlantic	%	Total
1958	3, 321	41. 5	3, 373	42. 1	8	. 09	593	7. 4	708*	8. 8	8, 003
1959	3, 223	41. 6	2, 994	38. 7	123	1. 6	660	8. 3	737*	9. 5	7, 737
1960	2, 996	42. 7	2, 550	36. 4	285	4. 0	593	8. 4	590*	8. 4	7, 014
1961	4, 269	40. 3	4, 455	42. 0	334	3. 1	586	5. 5	958*	9. 0	10, 602
1962	4, 254	47. 7	3, 130	35. 2	214	2. 4	646	7. 2	664	7. 4	8, 908
1963	4, 896	39. 8	5, 407	44. 0	248	2. 0	693	5. 6	1, 044	8. 9	12, 288
1964	5, 200	36. 0	7, 252	50. 2	206	1. 4	656	4. 5	1, 129	7. 8	14, 443
Average for 6 Seaway years	4, 139	38. 9	4, 679	44. 0	235	2. 2	639	6. 0	945	8. 9	10, 637

* Estimated from Shipping Statistics, D.B.S.

TABLE 12

CANADIAN COARSE GRAIN[1] EXPORTS BY SEABOARD SECTOR
Calendar Years: 1958 - 1964
'000 Tons

Year	Pacific	%	St. Lawrence	%	Lakehead Direct	%	Churchill	%	Atlantic	%	Total
1958	932	46.2	1,011	50.2	9	0.4	5	0.2	58*	2.9	2,014
1959	1,169	70.4	135	8.1	327	19.6	2	0.1	28*	.8	1,661
1960	802	61.0	220	16.8	275	20.8	1	-	15*	1.1	1,313
1961	1,019	79.6	182	14.2	68	5.4	-	-	10*	.8	1,279
1962	465	51.4	232	25.7	199	22.0	-	-	6	0.9	902
1963	590	54.4	187	17.2	273	25.2	-	-	33	3.2	1,083
1964	1,074	71.9	179	11.9	228	15.2	-	-	13	0.9	1,494
Average for Seaway years	848	66.1	198	15.4	228	17.8	-	-	9	0.7	1,283

1) Oats, Barley, Rye, Flax.

* - See Table 10.

TABLE 13

DESTINATION OF WHEAT EXPORTS BY EXPORT SECTOR
1957-58 to 1963-64
000 Tons

	1957-58		1959-60		1960-61		1961-62		1962-63		1963-64	
	Pacific	St. Lawrence **	Pacific	St. Lawrence **	Pacific	St. Lawrence	Pacific	St. Lawrence	Pacific	St. Lawrence	Pacific	St. Lawrence
EEC Europe	770	1207	233	1227	389	1773	362	1409	170	1161	271	1276
Other Western Europe	1158	2188	567	1670	362	1766	361	1689	247	1427	378	1626
Eastern Europe	300	189	112	35	227	669	23	656	23	658	1038	5385
Africa	18	-	210	70	3	24	67	26	242	18	102	10
Mid-East	21	22	90	54	48	-	-	55	13	56	26	46
West Hemisphere	128	8	198	23	161	22	211	26	233	31	303	159
Asia *	1579	561	1465	200	2570	371	3517	281	3290	11	3074	1

* Including Oceania
** Including Atlantic

Source: Canadian Grain Exports.

TABLE 13a

DESTINATION OF WHEAT EXPORTS BY EXPORT SECTOR
1957-58 to 1963-64
'000 Tons

B. OTHER SECTORS

	1960-61			1961-62			1962-63			1963-64		
		Direct			Direct			Direct			Direct	
	Churchill	Lakehead	Atlantic	Churchill	Lakehead	Atlantic	Churchill	Lakehead	Atlantic	Churchill	Lakehead	Atlantic
EEC Europe	49	109	Not Avai-lable	74	80	Not Avai-lable	185	103	78	166	43	203
Other Western Europe	560	205		498	212		474	96	426	490	51	328
Eastern Europe	-	-		-	-		-	-	-	-	95	1,011
Africa	-	-		-	-		-	11	5	-	4	-
Mid-East	-	-		-	-		-	-	4	-	-	1
Western Hemisphere	-	19		-	7		-	22	23	-	36	89
Asia	-	-		-	-		-	-	21	-	-	-

N.B. **Years 1957-58 and 1959-60, Not Fully Available.**

TABLE 14

EXPORTS OF CANADIAN COARSE GRAINS BY MARKET AREA & CLEARANCE SECTOR
Crop Years: 1962-3 & 1963-4

'000 Tons

	1962 - 63		1963 - 1964	
	Pacific	St. Lawrence[1]	Pacific	St. Lawrence[1]
Western Europe				
E. E. C.	177. 1	168. 8	239. 8	105. 1
Other	139. 8	70. 6	45. 6	180. 5
Total	316. 9	239. 4	285. 4	285. 6
Eastern Europe	-	4. 2	71. 9	1. 2
Africa	-	7. 3	4. 9	9. 64
Asia	137. 8	1. 8	578. 8	-
Western Hemisphere	1. 6	-	44. 2	-
U. S.	-	11. 5	-	43. 3
Total by Direction	456. 3	264. 2	985. 2	444. 5
TOTAL	720. 5		1, 429. 7	

1) Excludes Atlantic Ports

Source: Board of Grain Commissioners
Annual "Canadian Grain Exports".

TABLE 15

LAKE SHIPMENTS CANADIAN GRAIN FROM LAKEHEAD
BY TYPES OF GRAIN
1953 - 1964
'000 Short Tons

Year	Wheat	Oats	Barley	Rye	Flaxseed	Total
1953	6, 337	1, 584	2, 630	491	174	11, 216
1954	4, 263	943	1, 920	235	121	7, 582
1955	4, 291	514	1, 617	308	474	7, 204
1956	6, 246	766	2, 185	307	286	9, 790
1957	4, 764	786	1, 350	118	320	7, 338
1958	5, 817	674	1, 769	147	241	8, 648
1959	5, 670	517	1, 325	130	183	7, 825
1960	5, 590	437	1, 309	101	233	7, 670
1961	7, 387	383	1, 100	119	222	9, 211
1962	5, 542	359	708	170	221	7, 000
1963	7, 619	684	1, 037	103	198	9, 641
1964	10, 585	541	1, 017	136	259	12, 538

Source: Canadian Wheat Review,
December, 1964.
D. B. S.

TABLE 16

VESSEL SHIPMENTS OF WHEAT FROM LAKEHEAD
Navigation Seasons 1958 - 1964

By Destination - Millions of Tons

Year	Bay & Lake	Above Welland	St. Lawrence Ports	Direct Overseas	Atlantic Ports	U. S.
1958	5.5	-	.07	.01	-	.15
1959	4.3	-	.94	.25	.02	.04
1960	3.3	-	1.7	.28	.09	.10
1961	3.7	-	3.0	.33	.11	.08
1962	2.5	-	2.6	.21	.11	.05
1963	2.5	1.1	4.6	.25	.12	.03
1964	2.4[1]	1.8[1]	6.8	.20	1.10	-

1) Including U. S. Shipments

Source: Special Seaway Study - 1962.
D. B. S. Shipping Report - 1963.
St. Lawrence Seaway Authority Reports.

SHIPMENTS OF GRAIN FROM LAKEHEAD BY DESTINATION
1963

Millions of Tons

		Wheat		Other Grain		Total
TOTAL SHIPMENTS		7.60[1]		2.00		9.60
Shipments to Bay & Lake above Welland	1.75		.43		2.47	
Less Trans-ship	- .61		-		- .90	
Add U.S. Shipments	.03	1.17	.18	.61	-	1.78
Total Shipped through Welland		6.43		1.39		7.82
Ontario Sector (Net) To	.956					
From	.642	.31		.27[3]		.57
Total Seaway Shipments		6.12		1.12		7.25
By Destination:						
St. Lawrence Ports	4.67		.728		5.398	
Trans-ship[2]	1.04		.019		1.059	
Atlantic Direct	.12		.04		.16	
Trans-ship	.05		-		.05	
Direct Overseas	.25		.235		.485	
TOTAL		6.13		1.12		7.15

1) D. B. S. Shipping Report shows 7.25 million tons and difference has been credited to Shipments to St. Lawrence Ports.

2) Trans-shipments: From above Welland .404
Lake Ontario to St. Lawrence .642
1.046

3) Shipped in - .285
out - .018
Balance - .257

TABLE 18

SHIPMENTS OF GRAIN FROM LAKEHEAD BY DESTINATION
1964

Millions of Tons

		Wheat		Coarse Grains		Total
TOTAL SHIPMENTS		10.5		2.03		12.53
Shipments to Bay & Lake & U. S. above Welland		1.8		.84		2.64
Total Shipped through Welland		8.7		1.19		9.89
Lake Ontario		.6		.35		.95
Total Montreal - Lake Ontario		8.1		.84		8.94
By Destinations:						
St. Lawrence Ports	6.8		.61		7.41	
Atlantic	1.1		-		1.1	
Direct Overseas	.2	8.1	.23	.84	.43	8.94
EXPORTS						
Pacific	5.2		1.07		6.27	
Churchill	.6		-		.6	
Eastern	8.6	14.4	.42	1.49	9.02	15.89

Source: St. Lawrence Seaway Authority. 1964.

TABLE 19

DISTRIBUTION OF CANADIAN GRAIN SHIPMENTS VIA GREAT LAKES
1958 - 1964
('000 Tons)

	Total Shipped		Exported		Domestic Use	
	Wheat	Coarse Grain	Wheat	Coarse Grain	Wheat	Coarse Grain
1958	5,817	2,831	4,089	1,078	1,728	1,753
1959	5,670	2,155	3,854	490	1,816	1,665
1960	5,590	2,080	3,425	510	2,165	1,570
1961	7,387	1,824	5,747	260	1,640	1,564
1962	5,542	1,458	4,008	437	1,534	1,021
1963	7,619	2,022	6,696	493	923	1,529
1964	10,858	1,953	8,587	420	2,271	1,533
Six Year Averages 1959-64:	7,111	1,915	5,386	435	1,725	1,480
TOTALS	9,026		5,821		3,205	

Source: Canadian Grain Exports.

TABLE 20

GRAIN PRODUCTION GREAT LAKES "HINTERLAND" BY STATES
1958 - 1962, 1963, 1964
(Millions of Tons)

	Average 1958-62	1963	1964
Montana	3.7	3.9	3.8
North Dakota	7.5	8.5	9.5
South Dakota	5.9	7.1	5.4
Nebraska	12.1	10.7	8.6
Minnesota	14.0	15.8	13.7
Iowa	25.8	29.8	26.1
Wisconsin	5.3	5.0	5.7
Indiana	11.8	15.5	12.4
Ohio	9.0	10.0	8.3
Illinois	25.4	29.1	25.8
Michigan	4.6	4.8	4.8
TOTALS	125.1	140.5	124.1

Source: Compiled from U. S. Department of Agriculture Data.

TABLE 21

U.S. GRAIN SHIPMENTS VIA WELLAND CANAL
1959 - 1964

Year	Total Exports via U.S. Ports above Welland	Deduct Exports to Canada above Welland	Add U.S. Lake Ontario Domestic	Total Welland
1959	3,452	115	115	3,452
1960	3,971	67	132	4,036
1961	4,536	188	69	4,417
1962	6,275	222	90	6,143
1963	6,319	101	65	6,283
1964	6,997	200[1]	100[1]	6,898

1. Estimated.

TABLE 22

MOVEMENT OF U. S. GRAIN VIA WELLAND CANAL & SEAWAY
1959 - 1964

'000 Tons

	Shipments[1] via Welland	To Lake Ontario Ports		Shipments via Montreal- Lake Ontario	To Canada		Exports
		Canada	U. S.		Domestic	Trans-shipments	Direct
1959	3, 452	209	115	3, 129	150	923	2, 056
1960	4, 036	595	132	3, 309	333	554	2, 422
1961	4, 417	540	69	3, 808	518	1, 242	2, 048
1962	6, 143	649	90	5, 404	416	1, 517	3, 471
1963	6, 283	661	65	5, 557	167	3, 354	2, 036
1964	6, 897	667	100	6, 130	264	2, 684	3, 182

1) Exports, plus U. S. - Lake Ontario Deliveries, less exports to Canada above Welland.

TABLE 23

U.S. GRAIN EXPORTS TO CANADA VIA GREAT LAKES
1958 - 1964
('000 Tons)

Year	Total	Above Welland	Via Welland	Lake Ontario	Via Seaway
1959	473	115	357	209	148
1960	995	67	927	595	332
1961	1,246	188	1,058	540	518
1962	1,287	222	1,064	649	415
1963	1,027	101	926	661	265[1]
1964	1,236	200	1,036	667	369

Source: U. S. Corps of Army Engineers Traffic Reports;
U. S. D. A. Marketing Research Report, and
St. Lawrence Seaway Traffic Report 1963 - 64.

TABLE 24

SEAWAY EXPORTS OF GRAIN BY PORTS
1959 - 1964

	1958	1959	1960	1961	1962	1963	1964
Duluth & Superior	258	1,980	2,305	2,151.3	2,631.1	2,362.5	2,703.4
Milwaukee	19	99	128	290.3	368.9	300.5	357.3
Chicago	421	1,009	942	746.5	1,426.2	1,841.0	2,049.1
Toledo	143	361	592	946.9	1,537.3	1,549.7	1,426.6
Other[1]	—	3	4	401.0	312.0	266.0	461.0
TOTAL	841	3,452	3,971	4,536.0	6,275.5	6,319.7	6,997.4

1) Estimated

Source: Chicago Association of Commerce & Industry Compilation of U. S. Bureau of Census Data.

TABLE 25

SAMPLE RAILROAD CHARGES AND COSTS
U.S. EXPORT GRAIN 1957
(cents per bushel)

From Decatur, Ill. To	Rate[1]	Cost[2] Out of Pocket	Fully Distributed
Baltimore, Md.			
Wheat	18.90	17.21	25.89
Corn	17.64	16.25	24.35
Barley	15.12	14.63	21.58
Soyabeans	25.80	17.36	26.05
Chicago, Ill.			
Wheat	14.40	6.95	9.95
Corn	13.44	6.57	9.37
Barley	11.52	5.95	8.35
Soyabeans	14.40	7.01	10.00
New Orleans, La.			
Wheat	20.70	14.78	23.68
Corn	19.32	14.29	22.60
Barley	16.56	12.73	19.85
Soyabeans	28.80	15.09	23.99
New York, N. Y.			
Wheat	19.80	19.61	29.63
Corn	18.48	18.51	27.86
Barley	15.84	16.66	24.67
Soyabeans	26.70	19.79	29.81

Source: U. S. D. A. Market Research Report No. 319.

1) Based on published tariffs.
2) Data supplied by the I. C. C.

TABLE 26

GRAIN RAIL RATES EXPORT MOVEMENT
SELECTED POINTS OF ORIGIN & EXPORT
1957 & 1965

cents per bushel

FROM		WHEAT 1957	WHEAT 1965	CORN 1957	CORN 1965	SOYBEANS 1957	SOYBEANS 1965
Decatur To							
Chicago		14.40	12.90	13.44	12.04	14.40	15.90
New Orleans		20.70	19.50	19.32	18.20	28.80	23.10
Baltimore		18.90	22.50	17.64	21.00	25.80	23.10
Omaha To							
Chicago	Flat		23.40		16.80		20.70
	Prop	18.30	16.20	17.08	15.12	18.30	16.20
Baltimore		37.20	33.90	34.72	31.64	44.10	34.50
New Orleans	Flat	27.60	30.00	25.76	28.00	27.60	30.00
	Prop		29.70		20.16		29.70
Kearney, Neb. To							
Chicago		35.10	28.50	32.76	26.60	35.10	28.50
New Orleans		44.40	30.90	41.44	28.84	44.40	30.90
St. Louis To							
Chicago		18.00	12.90	16.80	12.04	18.00	19.50
New Orleans		14.40	15.90	13.44	14.84	14.40	15.30
Mankato To							
Chicago		n/a	23.70	n/a	20.72	n/a	22.20
Duluth		18.30	12.30	17.08	8.96	18.30	9.60
Minot To							
Chicago		n/a	47.70	n/a	44.52	n/a	47.70
Duluth		29.10	31.20	27.16	29.12	29.10	31.20
Shelby							
Duluth		48.60	48.00	n/a	44.80	n/a	n/a
Portland		40.20	40.20	n/a	37.52	n/a	n/a

TABLE 27

SCHEDULE SHOWING MEASURE OF REDUCTIONS IN FLAT AND PROPORTIONAL GRAIN RATES TO AND OVER CHICAGO, ILLINOIS AND SOUTHEASTERN WISCONSIN AND MISSISSIPPI RIVER POINTS IN IOWA AND MISSOURI

To: Chicago, Ill.		Old Rates in effect prior 7/15/65			New Reduced Rate Effective 7/15/65	Cents Reduction		
		Export	Domestic			Export	Domestic	
From:			Normal Basis	Gathering Basis			Normal Basis	Gathering Basis
		(Cwt)	(Cwt)	(Cwt)	(Cwt)	(Cwt)	(Cwt)	(Cwt)
Aurora, Ill.		12. 0	18. 5	12. 0	12. 0	-	6. 5	-
Mendota, Ill.		14. 5	23. 5	14. 5	14. 5	-	9. 0	-
Buda, Ill.		15. 0	26. 0	15. 0	15. 0	-	9. 0	-
Oneida, Ill.		26. 0	29. 5	-	19. 5	6. 5	10. 0	-
Burlington, La.		32. 5	32. 5	-	22. 5	10. 0	10. 0	-
Davenport, La.		29. 5	29. 5	-	19. 5	10. 0	10. 0	-
Hannibal, Mo.		32. 5	32. 5	-	22. 5	10. 0	10. 0	-
Bearstown, Ill.	Flat	32. 5	32. 5	-	22. 5	10. 0	10. 0	-
	Prop	-	-	-	18. 0	14. 5	14. 5	-
E. St. Louis, Ill.	Flat	21. 5	32. 5	-	24. 5	-	8. 0	-
	Prop	-	-	-	16. 5	5. 0	16. 0	-

NOTES:

1) Different set of rates based on same rational apply to and over Peoria.

2) Higher minimum weights per carload are applicable under the new rates - e. g. 80, 000 lbs. or more, depending on car used vs. old minimum weight requirement of 50, 000 lbs. or over, depending on car used.

3) Only 2 stops for transit under the new rates.

TABLE 28

FORECAST RANGE OF SEAWAY GRAIN TRAFFIC (Canadian) 1970 - 1985

Millions of Short Tons

	1970			1980			1985		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Production	26.8	34.5	47.0	26.8	43.9	56.1	26.8	48.3	60.5
Prairie Consumption	14.9	16.6	21.3	15.3	22.3	26.0	15.5	24.5	28.8
Available for shipment from Prairies	11.9	17.9	25.7	11.5	21.6	30.1	11.3	23.8	31.7
Exports									
Pacific	7.7	6.5	5.3	6.7	8.3	7.6	5.9	9.3	8.5
Churchill	.2	.6	.7	.3	.7	.7	.4	.7	.7
St. Lawrence	1.6	7.0	16.0	1.7	8.3	16.8	1.8	9.2	17.0
	9.5	14.1	22.0	8.7	17.3	25.1	8.1	19.2	26.2
Domestic Shipments	2.4	3.8	4.7	2.8	4.3	5.0	3.2	4.6	5.5
Total	11.9	17.9	25.7	11.5	21.6	30.1	11.3	23.8	31.7
Total Lakehead	4.0	10.8	19.7	4.5	12.6	21.8	5.0	13.8	22.5
via Welland	3.1	9.6	17.4	3.9	11.4	19.4	4.3	11.9	20.1
via St. Lawrence	2.4	8.9	16.1	3.2	10.3	18.0	3.6	10.9	18.9

NOTE: These ranges represent possible but unlikely extremes. While there is no statistical basis for setting confidence limits to the mean forecast, such limits based on judgment can be expressed as follows: In the opinion of the authors the mean forecasts plus or minus 15% have a 90% likelihood of indicating actual traffic levels.

TABLE 29

LAKE SHIPMENTS OF CANADIAN WHEAT
1963 - 1985

	1963	1964	1970	1980	1985
From Lakehead to:	7. 60	10. 5	8. 3	9. 72	10. 8
above Welland (bay, lake & U. S.)	1. 17	1. 8	. 8	. 75	. 8
via Welland	6. 43	8. 7	7. 5	8. 97	10. 0
Lake Ontario (net)	. 31	. 6	. 3	. 45	. 6
via Montreal - Lake Ontario Sector	6. 12	8. 1	7. 2	8. 52	9. 4
			COARSE GRAIN		
From Lakehead to:	2. 0	2. 3	2. 46	2. 88	3. 23
above Welland	. 61	. 84	. 35	. 60	. 7
via Welland	1. 39	1. 19	2. 11	2. 28	2. 53
Lake Ontario (net)	. 27	. 35	. 35	. 5	. 7
	1. 12	. 84	1. 76	1. 78	1. 83
TOTAL	7. 24	8. 94	8. 96	10. 30	11. 33

TABLE 30

LAKE SHIPMENTS OF CANADIAN COARSE GRAIN 1963 - 1985

		1963		1964		1970		1980		1985
Total Shipped from Lakehead		2.0		2.03		2.46		2.88		3.23
above Welland										
Domestic	.43		.76		.30		.50		.60	
U. S.	.18	.61	.08	.84	.05	.35	.10	.60	.10	.70
via Welland		1.39		1.19		2.11		2.28		2.53
Domestic	1.05		.77		1.36		1.3		1.40	
Export	.34		.42[1]		.75		.98		1.13	
Lake Ontario Sector (net)										
Domestic		.27		.35		.35		.5		.7
Montreal-Lake Ontario Sector		1.12		.84		1.76		1.78		1.83
Domestic	.78		.42		1.01		.80		.70	
Export	.34		.42		.75		.98		1.13	
Total Domestic	1.48		1.53		1.66		1.8		2.00	
Export - U. S.	.18		.08		.05		.10		.10	
Export Shipments via Seaway	.34	2.0	.42	2.03	.75	2.46	.98	2.88	1.13	3.23

1) Exports to U. S. not included in total.

TABLE 31

LAKE SHIPMENTS OF CANADIAN WHEAT VIA
THE WELLAND CANAL & MONTREAL - LAKE ONTARIO SECTOR

		1963		1964		1970		1980		1985
Total Shipped from Lakehead:		7.60		10.5		8.3		9.72		10.8
above Welland										
Domestic	.30		1.0		.8		.75		.8	
Other (U.S.) & Rail	.87	1.17	.8	1.8	.0[2]	.8	-	.75	.0	.8
via Welland		6.43		8.7		7.5		8.97		10.0
Domestic	.60		1.2		1.3		1.72		2.1	
Other	5.83		7.5		6.2		7.25		7.9	
Lake Ontario Sector (net)										
Domestic	.31	.31	.6	.6	.3	.3	.45	.45	.6	.6
Montreal-Lake Ontario Sector		6.12		8.1		7.2		8.52		9.4
Domestic	.29		.6		1.0		1.27		1.5	
Export	5.83		7.5		6.2		7.25		7.9	
Total Domestic	.9		2.2		2.1		2.47		2.9	
Total Exported via Seaway	5.83		7.5		6.2		7.25		7.9	
Export shipments via Rail -	.87	7.60	.80	10.5		8.3	-	9.72	-	10.8

1) Estimated on Basis of excess of total export movement via Lakehead over tonnage transitting Seaway.

2) It has been assumed that rail shipments to the Maritimes will cease by 1970.

TABLE 32

FORECAST OF CANADIAN GRAIN SHIPMENTS BY DESTINATION
1970 - 1985
(Millions of short tons)

	Average 1959 - 1964			1970			1980			1985		
	Wheat	Coarse Grain	Total	Wheat	Coarse Grain	Total	Wheat	Coarse Grain	Total	Wheat	Coarse Grain	Total
Total Production	14.50	13.4	27.9	17.0	17.5	34.5	21.4	22.5	43.9	23.8	24.5	48.3
Prairie Consumption	2.72	10.6	13.32	2.9	13.74	16.44	4.33	18.0	22.33	4.8	19.7	24.5
Available for Shipment												
from Prairies for	11.78	2.80	14.58	14.1	3.76	18.06	17.07	4.5	21.57	19.0	4.8	23.8
Export Pacific	4.14	.84	4.98	5.3	1.2	6.5	6.6	1.7	8.3	7.3	1.85	9.15
Churchill	.63	-	.63	.6	-	.6	.7	-	.7	.7	-	.7
Lakehead	5.38	.43	5.81	6.2	.8	7.0	7.25	1.08	8.33	7.9	1.23	9.13
Total	10.15	1.27	11.42	12.1	2.0	14.1	14.55	2.78	17.33	15.9	3.08	18.98
- Domestic Total	1.68	1.48	3.16	2.1	1.66	3.76	2.47	1.80	4.27	2.9	2.00	4.9
Total	11.83	2.75	14.58	14.2	3.66	17.8	17.02	4.58	21.60	18.8	5.08	23.88
Shipped from Lakehead[1]	7.60	1.91	9.51	8.3	2.46	10.76	9.72	2.88	12.60	10.8	3.23	14.03
via Welland[1]	6.43	1.39	7.82	7.5	2.11	9.61	8.97	2.28	11.25	10.0	2.53	12.53
via Montreal and Lake Ontario	6.12	1.12	7.24	7.2	1.76	8.96	8.52	1.78	10.30	9.4	1.83	11.33
Previous Estimate			7.0			10.0			12.5			13.8
Difference			.24			1.04			2.2			2.47

1) Based on 1963 Movement.

TABLE 33

SHIPMENTS OF UNITED STATES GRAIN VIA
THE WELLAND CANAL AND MONTREAL - LAKE ONTARIO SECTOR
1959 - 1964 and Forecasts to 1980
Millions of Short Tons

	1963	1964	1970	1980[1]	1985[2]
Total Shipped Above Welland	8.6	8.3	10.25	12.8	14.5
Less Domestic & Canada above Welland	2.4	1.5	1.8	1.5	1.7
Total via Welland	6.2	6.8	8.4	11.3	12.8
Less Lake Ontario deliveries	.72	.76	.4	.5	.5
Total via Seaway	5.5	6.04	8.0	10.8	12.3

1) Based on 20% share of Exports.

2) Based on 22-1/2% share of Exports.

TABLE 34

FORECAST RANGE OF U. S. GRAIN SHIPMENTS ST. LAWRENCE SEAWAY SECTOR 1970 - 1985

Millions of Short Tons

	1970			1980			1985		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Total Shipped above Welland for Export	5. 6	8. 5	10. 0	7. 0	11. 4	14. 3	9. 0	12. 9	17. 5
Less Exports to Canada (above Welland)	. 1	. 1	. 1	. 1	. 1	. 1	. 1	. 1	. 1
Total Welland	5. 5	8. 4	9. 9	6. 9	11. 3	14. 2	8. 9	12. 8	17. 4
Less Exports to Canada - Lake Ontario	. 3	. 4	. 6	. 4	. 5	. 7	. 5	. 5	. 8
Total U. S. Seaway Traffic	5. 0	8. 0	9. 3	6. 5	10. 8	13. 5	8. 4	12. 3	16. 6

NOTE: These ranges represent possible but unlikely extremes. While there is no statistical basis for setting confidence limits to the mean forecast, such limits based on judgment can be expressed as follows : In the opinion of the authors the mean forecasts plus or minus 15% have a 90% likelihood of indicating actual traffic levels.

TABLE A-1

ANNUAL GRAIN IMPORTS BY REGIONS
PROJECTED BY SELECTED YEARS
Millions of Short Tons

Region	1959/61[1]	1970[2]	1975	1980	2000
Western Europe	28.0	31.1	33.0	35.0	37.4
Eastern Europe	6.6	7.0	6.0	4.0	5.0
U. S. S. R.	-7.5	3.0	-		
Total Europe	27.1	41.1	39.0	39.0	42.4
Africa	2.2	2.6	3.0	3.3	6.6
South America[3]	4.7	6.5	8.0	10.0	15.0
Asia	13.7	23.1	26.0	33.0	59.4

1. Source: World Food Budget - U. S. Department of Agriculture.
2. Source: Man, Land & Food - U. S. Department of Agriculture (As Revised).
3. Excluding Argentina.

TABLE A-2

FORECAST OF EXPORTS TO 1985
CANADIAN GRAIN

Millions of Short Tons

Country or Region	1963-64	1970	1975	1980	1985
Western Europe	5.6	6.5	6.8	7.3	7.6
Eastern Europe	7.5	1.3	1.4	1.6	1.7
Total Europe	13.1	7.8	8.2	8.9	9.3
Middle East	.07	.10	.12	.15	.2
Africa	.2	.15	.26	.35	.42
Western Hemisphere[1]	.87	1.25	1.47	1.8	2.1
Asia	3.65	4.9	5.4	6.0	6.5
Totals	17.82	14.20	15.87	17.2	18.52

1 Including U. S.

TABLE A-3

FORECAST OF EXPORTS TO 1985 CANADIAN WHEAT

Millions of Short Tons

Country or Region	1962-1963	1963-1964	1970	1975	1980	1985
Western Europe	4. 38	4. 83	5. 5	5. 7	6. 10	6. 3
E. E. C.	1. 65	1. 96	2. 2	2. 3	2. 5	2. 6
Other	2. 73	2. 87	3. 3	3. 4	3. 75	4. 0
Eastern Europe	. 68	7. 49	1. 2	1. 3	1. 5	1. 5
Middle East	. 07	. 07	. 10	. 12	. 15	. 2
Africa	. 27	. 09	. 12	. 22	. 3	. 35
Western Hemisphere	. 35	. 62	1. 0	1. 2	1. 5	1. 75
Asia	3. 30	3. 07	4. 2	4. 5	4. 9	5. 3
Totals	9. 05	16. 17	12. 12	13. 04	14. 45	15. 90

10 Year Average, 1954-1955 to 1963-1964 - 10. 4 Million tons.

TABLE A-4

FORECAST OF EXPORTS TO 1985
COARSE GRAINS

Millions of Short Tons

Country or Region	1963-1964	1970	1975	1980	1985
Western Europe:	.8	1.0	1.1	1.2	1.3
E. E. C.	.4				
Other	.4				
Eastern Europe	.09	.09	.1	.13	.16
Middle East	-	-	-	-	-
Africa	.13	.03	.04	.05	.07
Western Hemisphere[1]	.25	.25	.27	.3	.35
Asia	.58	.70	.9	1.1	1.2
Totals	1.85	2.07	2.41	2.78	3.08

1 Including U. S.

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